CP PUBLICATION

KVPY STREAM-SA

Practice Test Papers with Solutions

No of Test 10

CONTENTS

KVPY

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Stream – SA

Practice Set-1

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 There are 20 urns such that first urn contains 5 balls, the second contains 10 balls and in general the k^{th} urn contains $2k + 1$ balls more than that in $(k - 1)^{th}$ urn. Then the total number of balls in all the urns is -

(A) 3330 (B) 2890

(C) 2870 (D) 3311

Q.2 If x, y, z are positive numbers such that $xy + y + x = 23$, $xz + z + x = 41$, $yz + y + z = 27$ then $x + y + z$ equal to -

(A) 14 (B) 17 (C) 12 (D) 15

Q.3 If $S_n = \frac{7}{4.1.2} + \frac{10}{4^2.2.3} + \frac{13}{4^3.3.4} + \ldots$ then S_∞ is equal to -

(A) $\frac{5}{2}$ (B) $\frac{9}{8}$ (C) $\frac{3}{2}$ (D) 1

Q.4 The number of real solutions of the system of equations $1 + z^2 = 2x$, $1 + x^2 = 2y$, $1 + y^2 = 2z$ is -

(A) 1 (B) 2 (C) 3 (D) 4

Q.5 The remainder when 3^{33} is divided by 75 is

(A) 12 (B) 15 (C) 16 (D) 48

Q.6 The number of ordered pairs of positive integers (a, b) such that LCM of a & b is $2^3\ 5^7\ 11^{13}$ is -

(A) 2385 (B) 2835 (C) 3825 (D) 8325

Q.7 Number of polynomials of the form $x^3 + ax^2 + bx + c$ which are divisible by $x^2 + 1$, where $a, b, c \in \{1, 2, 3, ... 10\}$ are

(A) 5 (B) 10 (C) 20 (D) 100

Q.8 The number of solutions of $(\sin 2x + \cos 2x)^{1+\sin 4x} = 2$ in $[-\pi, \pi]$ are -

(A) 0 (B) 1 (C) 2 (D) 4

Q.9 Pipes A and B can completely fill a water tank independently in 4 hrs and 5 hrs respectively. A pipe C can empty the tank filled completely with water in 3 hrs. Initially the tank is empty and all the pipes are closed. Pipe A is opened first at time $t = 0$ hrs and pipe C is opened at the instant when the tank is exactly half filled with water. Pipe B is opened after pipe C and at the instant when the tank is exactly one fourth filled with water. Find the total time taken to fill the tank completely counting from $t = 0$ hrs.

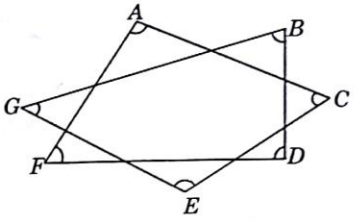
(A) $\frac{80}{7}$ hrs (B) 11 hrs

(C) $\frac{94}{7}$ hrs (D) 13 hrs

Q.10 Three boys A, B and C start running at constant speeds from the same point P along the circumference of a circular track. The speeds of A, B and C are in the ratio 5 : 1 : 1. A and B run clockwise while C runs in the anticlockwise direction. Each time A meets B or C on the track he gives them a card. What is the difference in the number of cards received by B and C if A distributes 33 cards in all ?

(A) 3 (B) 7 (C) 5 (D) 11

Q.11 If all line segments are straight, in the given figure, then the sum of the angles at the corners marked in the diagram is -



(A) 360° (B) 450° (C) 540° (D) 630°

Q.12 Three parallel lines ℓ_1, ℓ_2 and ℓ_3 are drawn through the vertices A, B and C of a square $ABCD$. If the distance between ℓ_1 and ℓ_2 is 12, then the area of the square $ABCD$ is -

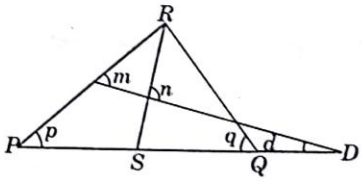
(A) 193 (B) 169 (C) 196 (D) 225

Q.13 If $x > y > 0$ and $2 \log (x - y) = \log x + \log y$, then x/y equals :

(A) $3 + \sqrt{5}$ (B) $\frac{3+\sqrt{5}}{2}$ only

(C) $\frac{3-\sqrt{5}}{2}$ only (D) $\frac{3 \pm \sqrt{5}}{2}$

Q.14 Given triangle PQR with RS bisecting $\angle R$, PQ extended to D and $\angle n$ a right angle, then



(A) $\angle m = \frac{1}{2}(\angle p - \angle q)$

(B) $\angle m = \frac{1}{2}\angle p + \angle q)$

(C) $\angle d = \frac{1}{2}(\angle q + \angle p)$

(D) $\angle d = \frac{1}{2}\angle m$

Q.15 How many ten digit numbers can be formed without repeating any digit and the difference of the digits at equal distances from the beginning and the end is always 1

(A) $1 \times 4! \times 2^4$ (B) $9 \times 4! \times 2^4$

(C) $8 \times 4! \times 2^4$ (D) $1 \times 4! \times 2^5$

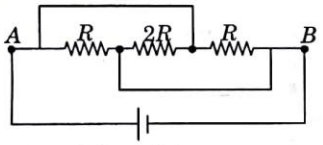
PHYSICS

Q.16 Ball 1 collides head on with an another identical ball 2 at rest. Velocity of ball 2 after collision becomes two times to that of ball 1 after collision. The coefficient of restitution between the two balls is -

(A) e = 1/3 (B) e = 1/2

(C) e = 1/4 (D) e = 2/3

Q.17 In the figure shown the current flowing through $2R$ is :



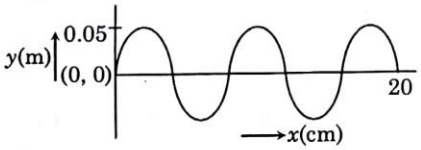
(A) from left to right

(B) from right to left

(C) no current

(D) None of these

Q.18 For the wave shown in figure, the equation for the wave, travelling along +x axis with velocity 350 ms^{-1} when its position at t = 0 is as shown



(A) $0.05 \sin(\frac{314}{4}x - 27475\,t)$

(B) $0.05 \sin(\frac{379}{5}x - 27475\,t)$

(C) $1 \sin(\frac{314}{4}x - 27475\,t)$

(D) $0.05 \sin(\frac{289}{5}x + 27475\,t)$

Q.19 $\Delta U = 0$ in a noncylic process of an ideal gas. The process :

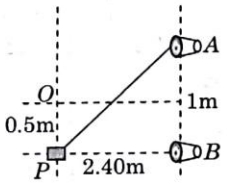
(A) may be isothermal

(B) must be isothermal

(C) may be adiabatic

(D) may be isobaric

Q.20 Two speakers A and B, placed 1 m apart, each produce sound waves of frequency 1800 Hz in phase. A detector moving parallel to line of speakers distant 2.4 m away detects a maximum intensity at O and then at P. Speed of sound wave is :



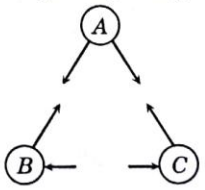
(A) 330 ms^{-1} (B) 360 ms^{-1}

(C) 350 ms^{-1} (D) 340 ms^{-1}

Q.21 A projectile is thrown with velocity v making an angle θ with the horizontal. It just crosses the top of two poles, each of height h, after 1 second and 3 second respectively. The time of flight of the projectile is -

(A) 1 s (B) 3 s (C) 4 s (D) 7.8 s

Q.22 The diagram shows the arrangement of three small uniformly charged spheres A, B and C. The arrows indicate the direction of the electrostatic forces acting between the spheres (for example, the left arrow on sphere A indicates the electrostatic force on sphere A due to sphere B). At least two of the spheres are positively charged. Which sphere, if any, could be negatively charged ?



(A) sphere A (B) sphere B

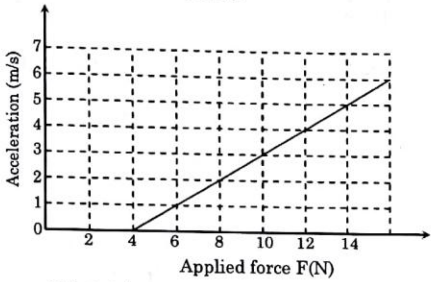
(C) sphere C (D) no sphere

Q.23 The resultant $\vec{A}$ and $\vec{B}$ makes an angle α with $\vec{A}$ and β with $\vec{B}$,

(A) $\alpha < \beta$ (B) $\alpha < \beta$ if $A < B$

(C) $\alpha < \beta$ if $A > B$ (D) $\alpha < \beta$ if $A = B$

Q.24 A block of unknown mass is at rest on a rough, horizontal surface. A force F is applied to the block. The graph in the figure shows the acceleration of the block with respect to the applied force. The mass of the block is -



(A) 1.0 kg (B) 0.1 kg

(C) 2.0 kg (D) 0.2 kg

Q.25 Weight of an object is :

(A) Normal reaction between ground and the object

(B) Gravitational force exerted by earth on the object

(C) dependent on frame of reference

(D) net force on the object

Q.26 The work done by kinetic friction on a body :

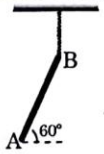
(A) is always negative

(B) is always zero

(C) may be +ve, –ve or zero

(D) is always positive

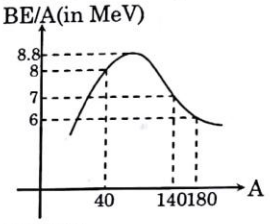
Q.27 A uniform rod of mass m and length ℓ is attached to smooth hinge at end A and to a string at end B as shown in figure. It is at rest. The angular acceleration of the rod just after the string is cut is :



(A) $\frac{3g}{2\ell}$ (B) $\frac{3g}{4\ell}$

(C) $\frac{5g}{4\ell}$ (D) $\frac{5g}{2\ell}$

Q.28 A heavy nucleus $x(A = 180)$ breaks into two nuclei $y(A = 140)$ and $z(A = 40)$. Energy released during fission reaction is :



(A) 110 MeV

(B) 220 MeV

(C) 200 MeV

(D) Energy is not released

Q.29 Which of the following is a correct relation ?

(A) Speed = |Velocity|

(B) Average speed = |Average velocity|

(C) $\frac{d}{dt}$ speed = $\left|\frac{d}{dt}\text{velocity}\right|$

(D) Distance = |Displacement|

Q.30 A particle of mass m describes a circle of radius r. The centripetal acceleration of the particle is $4/r^2$. What will be the magnitude of momentum of the particle ?

(A) $2\frac{m}{r}$ (B) $2\frac{m}{\sqrt{r}}$ (C) $4\frac{m}{\sqrt{r}}$ (D) None

CHEMISTRY

Q.31 Which of the following correctly explains the nature of boric acid in aqueous medium –

(A) $H_3BO_3 \xrightarrow{H_2O} H_3O^+ + H_2BO_3^-$

(B) $H_3BO_3 \xrightarrow{2H_2O} 2H_3O^+ + HBO_3^{2-}$

(C) $H_3BO_3 \xrightarrow{3H_2O} 3H_3O^+ + BO_3^{3-}$

(D) $H_3BO_3 \xrightarrow{H_2O} B(OH)_4^- + H^+$

Q.32 An ideal gas expand against a constant external pressure of 2.0 atmosphere from 20 litre to 40 litre and absorb 10 *kJ* of energy from surrounding. What is the change in internal energy of the system ?

(Given : 1 atm-litre = 101.3 *J*)

(A) 4052 *J* (B) 5948 *J*

(C) 14052 *J* (D) 9940 *J*

Q.33 The rate of diffusion of two gasses *X* and *Y* is in the ratio of 1 : 5 and that of *Y* and *Z* in the ratio of 1 : 6. The ratio of the rate of diffusion of *Z* with respect to *X* is :

(A) 5/6 (B) 1/30

(C) 6/5 (D) 30

Q.34 Which disproportionates on heating with NaOH ?

(A) P_4 (B) S

(C) Cl_2 (D) All of these

Q.35 Which is incorrect about N_2O_5 ?

(A) It is anhydride of HNO_3

(B) In solid state it exists as NO_2^+ NO_3^-

(C) It is structurally similar to P_2O_5

(D) It can be prepared by heating HNO_3 over P_2O_5

Q.36 Which one of the following pairs of solution can we expect to be isotonic at the same temperature?

(A) 0.1 *M* urea and 0.1 *M* $NaCl$

(B) 0.1 *M* urea and 0.2 *M* $MgCl_2$

(C) 0.1 *M* $NaCl$ and 0.1 *M* Na_2SO_4

(D) 0.1 *M* $Ca(NO_3)_2$ and 0.1 *M* Na_2SO_4

Q.37 The freezing point of equimolal solution in aqueous medium will be highest for –

(A) $C_6H_5NH_3Cl$ (B) $Ca(NO_3)_2$

(C) $La(NO_3)_3$ (D) $C_6H_{12}O_6$

Q.38 Among the carbonates of alkali metals which one has highest thermal stability ?

(A) Cs_2CO_3 (B) Rb_2CO_3

(C) K_2CO_3 (D) Na_2CO_3

Q.39 Al_4C_3 is an ionic carbide, named as -

(A) Acetylide (B) Methanide

(C) Allylide (D) Alloy

Q.40 The hydrocarbon which does not decolourise alkaline $KMnO_4$ solution and also does not give any precipitate with ammonical silver nitrate is

(A) benzene (B) acetylene

(C) propyne (D) butyne-1

Q.41 In a flask colourless N_2O_4 is in equilibrium with brown coloured NO_2. At equilibrium when the flask is heated at 100°*C*, the brown colour deepens and on cooling it becomes less coloured. The change in enthalpy, ΔH for this system is-

(A) Negative (B) Positive

(C) Zero (D) Undefined

Q.42 Boron can undergo the following reactions with the given enthalpy changes:

$2B(s) + \frac{3}{2} O_2(g) \rightarrow B_2O_3(s)$; $\Delta H = -1260\ kJ$

$2B(s) + 3H_2(g) \rightarrow B_2H_6(g)$; $\Delta H = 30\ kJ$

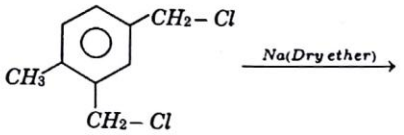
Assume no other reactions to be occurring.

If in a container (operating at constant pressure) which is isolated from the surrounding, mixture of $H_2(gas)$ and $O_2(gas)$ are passed over excess of $B(s)$, then calculate the molar ratio (O_2 : H_2) so that temperature of the container do not change:

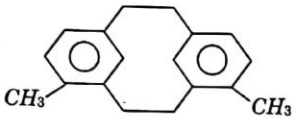
(A) 15 : 3 (B) 42 : 1

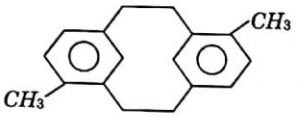
(C) 1 : 42 (D) 1 : 84

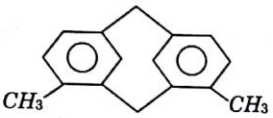
Q.43



Products obtained in above Wurtz reaction is –

(A) 

(B) 

(C) 

(D) Both (A) and (B)

Q.44 Benzene reacts with Cl_2 in sunlight to give a final product -

(A) C_6Cl_6 (B) C_6H_5Cl

(C) $C_6H_6Cl_6$ (D) CCl_4

Q.45 Potassium when heated strongly in oxygen, it forms –

(A) K_2O (B) KO_2

(C) K_2O_2 (D) KO_3

BIOLOGY

Q.46 The bacteria cell wall contains

(A) Cellulose (B) Chitin

(C) Pectin (D) Peptidoglycan

Q.47 During cell cycle DNA synthesis takes place in

(A) Entire cycle (B) S-phase

(C) G_1 phase (D) G_2 phase

Q.48 The path of water from soil up to secondary xylem is -

(A) Soil → Root hair cell wall → Cortex → Endomermis → Pericycle → Protoxylem → Metaxylem

(B) Cortex → Root hair → Endodermis → Pericycle → Protoxylem → Metaxylem

(C) Pericycle → Soil → Root hair → Cortex → Endomermis → Protoxylem → Metaxylem

(D) Soil → Root hair cell wall → Cortex → Pericycle → Endomeris → Protoxylem → Metaxylem

Q.49 Active absorption of water from the soil by the root is mainly affected by

(A) Respiration activity of root

(B) Tension on cell sap due to transpiration

(C) Tissue organisation

(D) None of the above

Q.50 Match the columns and find the correct combination

a. Grana of chloroplast	i. Krebs cycle
b. Stroma of chloroplast	ii. Light reaction
c. Cytoplasm	iii. Dark reaction
d. Mitochondrial matrix	iv. Glycolysis

(A) a-iv, b-iii, c-ii, d-i (B) a-i, b-ii, c-iv, d-iii

(C) a-ii, b-iii, c-iv, d-i (D) a-iii, b-iv, c-i, d-ii

Q.51 Why do fishes in an aquarium thrive better if green plants are growing there ? Because they

(A) Inhale oxygen released by green plants

(B) Inhale carbon dioxide released by green plants

(C) Like green surrounding

(D) Can feed on them

Q.52 Which of the following hormone is concerned chiefly with root initiation

(A) IBA (B) GA_3

(C) ABA (D) Kinetin

Q.53 The epithelial cells lining the stomach of vertebrates is protected from damage by hydrochloric acid because
(A) The epithelial cells are resistant to the action of hydrochloric acid
(B) Hydrochloric acid is neutralised by alkaline gastric juice
(C) The epithelial cells are covered with a mucus secretion
(D) Hydrochloric acid is too dilute

Q.54 Air is breathed through
(A) Trachea → Lungs → Larynx → Pharynx → Alveoli
(B) Nose → Larynx → Pharynx → Bronchus → Alveoli → Bronchioles
(C) Nostrils → Pharynx → Larynx → Trachea → Bronchi → Bronchioles → Alveoli
(D) Nose → Mouth → Lungs

Q.55 Which one of the following is NOT true ?
(A) Blood from right side of heart is carried to lungs by pulmonary artery
(B) Pleura are double convering of kidney
(C) Pancreas is both exocrine and endocrine gland
(D) Scurvy is due to vitamin C deficiency

Q.56 Find the matching pair
(A) Dup-sudden opening of semilunar valves at the beginning of ventricular systole
(B) Pulsation on radial artery - valves in blood vessels
(C) Initiation of heart beat - Purkinje fibres
(D) Lubb – Sharp closure of AV valves at the beginning of ventricular systole

Q.57 Valves which allow blood from ventricles into arteries and not in opposite direction are
(A) Aortic valve and mitral valve
(B) Bicuspid and tricuspid valve
(C) AV valves and semilunar valves
(D) Semilunar valves and tricuspid valves

Q.58 Which of the following is correct
(A) Afferent arteriole is narrower than efferent
(B) Efferent venule is narrower than vein
(C) Efferent arteriole is narrower than afferent arteriole
(D) None of these

Q.59 Endrocrine gland are those that put their secretions directly into
(A) Ducts (B) Blood
(C) Both (D) None of these

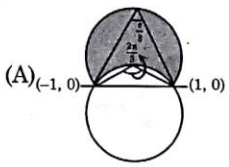
Q.60 What is true about hormones
(A) Hormones produced in one species usually perform same function in other species
(B) Only excess of hormones leads to serious consequences
(C) Chemically hormones are always steroids
(D) Hormones can be stored in certain body parts such as in liver and thyroid

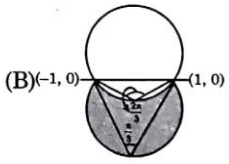
PART-II [Two Marks Questions]

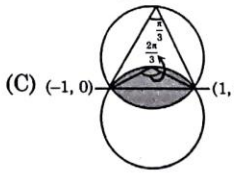
MATHEMATICS

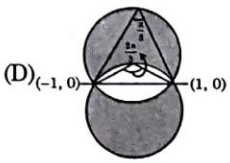
Q.61 If $(1+x+x^2+x^3)^n = a_0+a_1x+a_2x^2+.....+a_{3n}x^{3n}$ and $A = a_0+a_4+a_8+.....$ $B = a_2+a_6+a_{10}+....$ $C = a_3+a_7+a_{11}+.....$
(A) $3A + C = 2B$ (B) $A + C = B$
(C) $A + C = 2B$ (D) $A - C = B$

Q.62 If z satisfies $\frac{\pi}{3} < \text{Arg}\left(\frac{z-1}{z+1}\right) < \frac{2\pi}{3}$, then locus of z is represented by the shaded region in option.

(A) 

(B) 

(C) 

(D) 

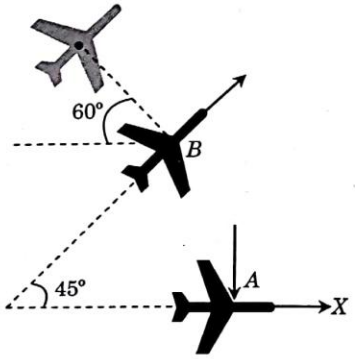
Q.63 If E_1 and E_2 are two events such that $P(E_1) = 1/4$, $P(E_2/E_1) = 1/2$ and $P(E_1/E_2) = 1/4$
(A) then E_1 and E_2 are independent
(B) E_1 and E_2 are exhaustive
(C) E_2 is thrice as likely to occur as E_1
(D) Probabilities of the events $E_1 \cap E_2$, E_1 and E_2 are not in G.P.

Q.64 If a, b, c are in A.P. a, mb, c are in G.P., then a, m^2b, c are in
(A) A.P. (B) G.P.
(C) H.P. (D) None of these

Q.65 The minimum value of the expression, $(\sin x + \text{cosec } x)^2 + (\cos x + \sec x)^2$ is :
(A) 3 (B) 9
(C) 27 (D) None of these

PHYSICS

Q.66 Passengers in the jet transport A flying east at a speed of 800 kmh^{-1} observe a second jet plane B that passes under the transport in horizontal flight. Although the nose of B is pointed in the 45° north east direction, plane B appears to the passengers in A to be moving away from the transport at the 60° angle as shown. The true velocity of B is –

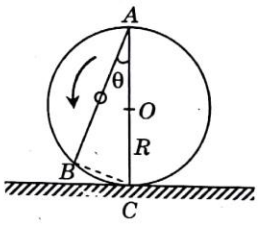


(A) $\frac{\sin 60°}{\sin 45°} \times 800\ km/hr$
(B) $\frac{\sin 45°}{\sin 60°} \times 800\ km/hr$
(C) $\frac{\sin 60°}{\sin 75°} \times 800\ km/hr$
(D) None

Q.67 If a car is moving towards a hill with 30 m/s and emitting sound of frequency 1000 Hz then calculate frequency detected by driver in reflected sound. If speed of sound in air is 330 m/s -
(A) 1000 Hz (B) 933 Hz
(C) 1200 Hz (D) 1100 Hz

Q.68 Calculate work-done by force $\vec{F} = 6\,\hat{i} - 3\,\hat{j}$ if particle displace from point (3, 2, 0) to (2, 1, –3) -
(A) –3 Joule (B) + 3 Joule
(C) zero (D) None of these

Q.69 A frictionless wire AB is fixed on a vertical ring of radius R. A very small sphereical ball slips on this wire. The time taken by the ball to slip from A to B is -

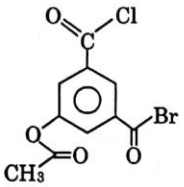


(A) $\frac{2\sqrt{gR}}{g\cos\theta}$ (B) $2\sqrt{gR}\,\frac{\cos\theta}{g}$
(C) $2\sqrt{\frac{R}{g}}$ (D) $\frac{gR}{\sqrt{g\cos\theta}}$

Q.70 A body is displaced from (0, 0) to ($1m$, $1m$) along the path $x = y$ by a force $\vec{F} = (x^2\hat{j} + y\hat{i})N$. The work done by this force will be –
(A) $\frac{4}{3}J$ (B) $\frac{5}{6}J$
(C) $\frac{3}{2}J$ (D) $\frac{7}{5}J$

CHEMISTRY

Q.71 Correct IUPAC name of the following compound is :



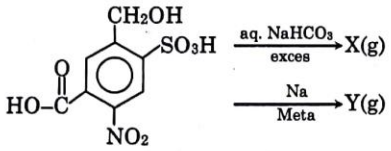
(A) Methyl 3-(Bromocarbonyl)-5 (Chlorocarbonyl) benzene carboxylate

(B) 3-(Methanoyloxy)-5-(Chlorocabonyl) benzene carbonyl bromide

(C) 3-(Bromocarbonyl)-5-(chlorocarbonyl) phenyl ethanoate

(D) 3-(Bromocarbonyl)-5-(ethanoyloxy) benzene carbonyl chloride

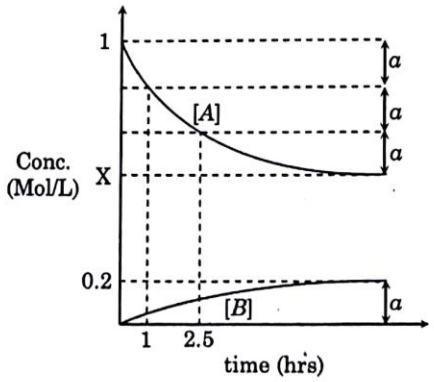
Q.72



In the above reaction find out the number of moles of the gases formed in the both reactions respectively ?

	$H_2(g)$	$SO_2(g)$	$CO_2(g)$	$NO_2(g)$
(A)	1.5	1	1	0
(B)	3	1	1	1
(C)	1.5	0	3	0
(D)	1.5	0	2	0

Q.73



Study the above graph for the reaction.

$nA \rightleftharpoons B$

and give answer to the following :

The value of 'n' and equilibrium constant K_C of above reaction is :

(A) 2, $\frac{8}{25}$ (B) 3, $\frac{25}{8}$

(C) 3, $\frac{8}{25}$ (D) 2, $\frac{25}{8}$

Q.74 The density of an unknown gas X is $\frac{80}{3}$ g/L at 600 K and 100 atm. The rate of diffusion of gas X is 0.25 times rate of diffusion of Helium under identical conditions. Which of the following conclusions is **incorrect** for gas X ?

(A) Molar mass of gas X is 64.

(B) The gas X behaves ideally under the given conditions

(C) The gas X is showing positive deviation from ideal gas behaviour

(D) The gas X diffuses faster than SO_3 under identical conditions

Q.75 A solution is 10^{-4} M in Cl^-, 10^{-5} M in Br^-. 10^{-3} M in I^-.$AgNO_3$(s) is added slowly to the solution. The minimum concentration of Ag^+ required to start precipitation of all three ions is 10^{-x} then the value of x is –

[Given, $K_{SP(AgCl)} = 10^{-10}$]

$K_{SP(AgBr)} = 10^{-13}$, $K_{SP(AgI)} = 10^{-17}$]

(A) 8 (B) 14

(C) 5 (D) 6

BIOLOGY

Q.76 Pruning makes the hedge plant dense because

(A) Injury induces growth

(B) Apical dominance is removed

(C) Root sprouts additional branches

(D) Pruning removes shade and allows germination of new seedings to impart a dense growth

Q.77 Light reaction occurs in -
(A) Grana/thylakoids
(B) Membrane of the chloroplast
(C) Stroma/Fret/Cytoplasm
(D) Cristae

Q.78 Given below is an incomplete table out certain hormones, their source glands and one major effect of each of the body in humans. Identify the correct option for the three blanks A, B and C.

GLAND	SECRETION	EFFECT OF BODY
A	Oestrogen	Maintenance of secondary sexual characters
Alpha cells of islets of Langerhans	B	Raises blood sugar level
Anterior pituitary	C	Over secretion leads to gigantism

Options :

	A	B	C
(A)	Ovary	Glucagon	Growth hormone
(B)	Placenta	Insulin	Vasopressin
(C)	Ovary	Insulin	Calcitonin
(D)	Placenta	Glucagon	Calcitonin

Q.79 Select the answer with correct matching of the structure, its location and function.

	Structure	Location	Function
(A)	Blind spot	Near the place where optic nerve leaves the eye	Rods and cones are present but inactive here
(B)	Eustachian tube	Anterior part of internal ear	Equalizes air pressure on either sides of tympanic membrane
(C)	Cerebellum	Mid brain	Controls respiration and gastric secretion
(D)	Hypothalamus	Fore brain	Controls Body temperature, urge for eating and drinking

Q.80 In which one of the following the genus name, its two characters and its, class/phylum are correctly matched?

	Genus Name		Two characters	Class/phylum
(A)	Ascaris	(a)	Body segmented	Annelida
		(b)	Males and females distinct	
(B)	Salamandra	(a)	A tympanum represents ear	Amphibia
		(b)	Fertilization is external	
(C)	Pteropus	(a)	Skin possesses hair	Mammalia
(D)	Aurelia	(a)	Cnidoblasts	Coelenterata
		(b)	Organ level of organisation	

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-2

Stream – SA

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 $|-2x^2+1+e^x+\sin x| = |2x^2-1| + e^x + |\sin x|$ if & only if 'x' belongs to

(A) $\left[0, \frac{1}{\sqrt{2}}\right]$ (B) R

(C) $[0, \pi]$ (D) $\left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$

Q.2 The no. of ways in which n^2 identical balls can be put in 'n. numbered boxes (1, 2, 3, ..., n) such that i^{th} box contains at least 'i' number of balls is-

(A) ${}^{n^2}C_{n-1}$ (B) ${}^{n^2-1}C_{n-1}$

(C) ${}^{n^2+n-2}C_{n-1}$ (D) None of these

Q.3 In shooting competition at Beijing a man could score 5, 4, 3, 2, 1 or 0 points for each shot. Then the no. of ways in which he could score 10 points in seven shots, is

(A) 6538 (B) 6548

(C) 6608 (D) None of these

Q.4 If a, b, c, d and e are five positive numbers then

(A) $\left(\frac{a}{b}+\frac{b}{c}\right)\left(\frac{c}{d}+\frac{d}{e}\right)\geq 4\sqrt{\frac{a}{e}}$

(B) $\left(\frac{a}{b}+\frac{c}{d}\right)\left(\frac{b}{c}+\frac{d}{e}\right)\geq 4\sqrt{\frac{a}{e}}$

(C) $\frac{a}{b}+\frac{b}{c}+\frac{c}{d}+\frac{d}{e}+\frac{e}{a}\geq 5$

(D) All three correct

Q.5 Triangle ABC has integral sides AB, BC measuring 2001 unit and 1002 unit respectively. Then the number of such triangles, is –

(A) 3002 (B) 2003

(C) 1003 (D) None of these

Q.6 A triangle has side 2, 3, 4. A tangent is drawn to the incircle parallel to side 2 cutting other two sides at X, Y. Then the length of XY, is -

(A) 9/10 (B) 2/9

(C) 10/9 (D) None of these

Q.7 The perimeter of a triangle is 2004. One side of the triangle is 21 times the other. The shortest side is of integral length. If length of one side of the triangle in every possible case, is x, then x =

(A) 47 or 48 (B) 46 or 47

(C) 45 or 46 (D) 45 or 48

Q.8 If two vertices of a triangle are (1, 3) & (4, –1) and area of triangle is 5 sq.units, then angle at third vertex lies in

(A) $\left(0, 2\tan^{-1}\frac{5}{4}\right]$ (B) $\left(0, \tan^{-1}\frac{5}{4}\right)$

(C) $\left(2\tan^{-1}\frac{5}{4}, 2\right)$ (D) None of these

Q.9 Let O be the origin and let $A(1,0)$, $B(0,1)$ be two points. If $P(x,y)$ is a point such that $xy > 0$ and $x + y < 1$ then -

(A) P lies either inside ΔOAB or in third quadrant

(B) P can not be inside ΔOAB

(C) P lies inside the ΔOAB

(D) None of these

Q.10 The roots of the equation $a(b-2c)x^2 + b(c-2a)x + c(a-2b) = 0$ are, when $ab + bc + ca = 0$

(A) 1, $\frac{c(a-2b)}{a(b-2c)}$ (B) $\frac{c}{a}$, $\frac{a-2b}{b-2c}$

(C) $\frac{a-2b}{a-2c}$, $\frac{a-2b}{b-2c}$ (D) None of these

Q.11 Circumradius of a ΔABC is 2, O is the circumcentre, H is the orthocentre then $\frac{1}{64}(AH^2+BC^2)(BH^2+AC^2)(CH^2+AB^2)$ is equal to -

(A) 64 (B) 16

(C) $\frac{1}{64}$ (D) 1

Q.12 The sum of the infinitely decreasing geometric progression is equal to the greatest value of the function $f(x) = 3x^3 - x - 76$ on interval [0, 3]; the first term of the progression is equal to the square of the common ratio. The common ratio of the $G.P.$ is-

(A) $\sqrt{2}-1$ (B) $\sqrt{3}-1$

(C) $\sqrt{2}+1$ (D) $\frac{1}{\sqrt{3}+1}$

Q.13 Six people, all of different weights, are trying to build a human pyramid, that is they get into the formation

A

B C

D E F

We say that some one not in the bottom row is "supported by" each of the two closest people beneath her or him. The number of possible different pyramids, if nobody can be supported by anybody of lower weight, are -

(A) 24 (B) 18 (C) 16 (D) 14

Q.14 If $\alpha = x + y + z + w$ and $\beta = (xy + yz + zw + wx + wy + xz)$ then which of the statement is true-

(A) $8\alpha^2 \geq 3\beta$ (B) $3\alpha^2 \geq 8\beta$

(C) $\alpha^2\beta \geq 27$ (D) None of these

Q.15 If α, β are the roots of $x^2 - 3x + \lambda = 0$ ($\lambda \in R$) and $\alpha < 1 < \beta$, then the true set of values of λ equals -

(A) $\lambda \in \left(2, \frac{9}{4}\right]$ (B) $\lambda \in \left(-\infty, \frac{9}{4}\right]$

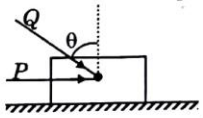
(C) $\lambda \in (2, \infty)$ (D) $\lambda \in (-\infty, 2)$

PHYSICS

Q.16 When a point charge of $\frac{1}{3}\mu C$ is placed along the axis of a thin disc of total charge $\frac{2}{3}\mu C$ (uniform distribution) and radius 3.95 cm such that distance between point charge and centre of disc is 1m, then force experienced by disc is approximately :

(A) 4mN (B) 6mN (C) 3mN (D) 2mN

Q.17 A block of mass m lying on a rough horizontal plane is acted upon by a horizontal force P and another force Q inclined at an angle θ to the vertical. The minimum value of coefficient of friction between the block and the surface for which the block will remain in equilibrium is -



(A) $\frac{P + Q\sin\theta}{mg + Q\cos\theta}$ (B) $\frac{P\cos\theta + Q}{mg - Q\sin\theta}$

(C) $\frac{P + Q\cos\theta}{mg + Q\sin\theta}$ (D) $\frac{P\sin\theta - Q}{mg - Q\cos\theta}$

Q.18 The decay constant of the end product of radioactive series is :

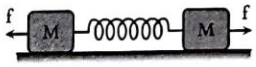
(A) zero

(B) infinite

(C) finite (non zero)

(D) depends on the end product

Q.19 A spring of force constant α has two blocks of same mass M connected to each end of the spring as shown in figure. Same force f extends each end of the spring. If the masses are released, then period of vibration is -



(A) $2\pi\sqrt{\frac{M}{2\alpha}}$ (B) $2\pi\sqrt{\frac{M}{\alpha}}$

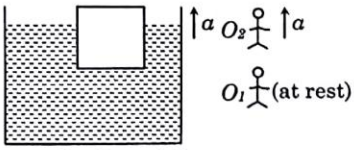
(C) $2\pi\sqrt{\frac{2\alpha M}{\alpha^2}}$ (D) $2\pi\sqrt{\frac{M\alpha^2}{2\alpha}}$

Q.20 One mole of an ideal gas at a temperature T_1 expands slowly according to the law $\frac{p}{V}$ = constant. Its final temperature is T_2. The work done by the gas is -

(A) $R(T_2 - T_1)$ (B) $2R(T_2 - T_1)$

(C) $\frac{R}{2}(T_2 - T_1)$ (D) $\frac{2R}{3}(T_2 - T_1)$

Q.21 A block is partially immersed in a liquid and the vessel is accelerating upwards with an acceleration "a". The block is observed by two observers O_1 and O_2, one at rest and the other accelerating with an acceleration "a" upward as shown in figure. The total buoyant force on the block is -



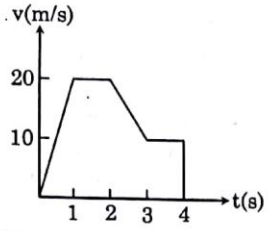
(A) same for O_1 and O_2

(B) greater for O_1 than O_2

(C) greater for O_2 than O_1

(D) data is not sufficient

Q.22 The variation of velocity of a particle moving along a straight line is shown in the figure. The distance travelled by the particle in 4 s is :



(A) 25 m (B) 30 m (C) 55 m (D) 60 m

Q.23 Two identical trains take 3 sec to pass one another when going in the opposite direction but only 2.5 sec if the speed of one is increased by 50%. The time one would take to pass the other when going in the same direction at their original speed is :

(A) 10 sec (B) 12 sec
(C) 15 sec (D) 18 sec

Q.24 Two persons are holding a light rope tightly at its ends so that it is horizontal. A 15 kg weight is attached to the rope at the mid point which now no longer remains horizontal. The minimum tension required to completely straighten the rope is -

(A) 15 kg
(B) $\frac{15}{2}$ kg
(C) 5 kg
(D) Infinitely large (or not possible)

Q.25 The distance moved by a particle in simple harmonic motion in one time period is -

(A) A (B) 2A (C) 4A (D) zero

Q.26 A closed pipe resonates at its fundamental frequency of 300 Hz. Which one of the following statements is wrong ?

(A) If the temperature rises, the fundamental frequency increases
(B) If the pressure rises, the fundamental frequency increases
(C) The first overtone is of frequency 900 Hz
(D) An open pipe with the same fundamental frequency has twice the length

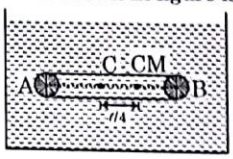
Q.27 A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0, a constant. Then the speed is maximum after the mass covers a distance of

(A) $\frac{\cos\theta}{\mu_0}$ (B) $\frac{\sin\theta}{\mu_0}$
(C) $\frac{\tan\theta}{\mu_0}$ (D) $\frac{2\tan\theta}{\mu_0}$

Q.28 A particle of mass m begins to slide down a fixed smooth sphere from the top. What is its tangential acceleration when it breaks off the sphere ?

(A) $\frac{2g}{3}$ (B) $\frac{\sqrt{5}g}{3}$ (C) g (D) $\frac{g}{3}$

Q.29 A non uniform cylinder of mass m, length ℓ and radius r is having its centre of mass at a distance $\ell/4$ from the centre and lying on the axis of the cylinder as shown in the figure. The cylinder is kept in a liquid of uniform density ρ. The moment of inertia of the rod about the centre of mass is I. The angular acceleration of point A relative to point B just after the rod is released from the position shown in figure is :



(A) $\frac{\pi\rho g\ell^2 r^2}{I}$ (B) $\frac{\pi\rho g\ell^2 r^2}{4I}$
(C) $\frac{\pi\rho g\ell^2 r^2}{2I}$ (D) $\frac{3\pi\rho g\ell^2 r^2}{4I}$

Q.30 Consider a solid uniformly charged sphere. There are two points A (inside) and B (outside) where the electric fields are same. The ratio of distance of A to the distance of B from the surface is :

(A) 1 : 1
(B) 2 : 1
(C) 1 : 2
(D) having many values

CHEMISTRY

Q.31 In the reaction

$3\,Cu + 8\,HNO_3 \rightarrow 3\,Cu(NO_3)_2 + 2NO + 4\,H_2O$

;what is the equivalent weight of HNO_3? if molecular weight of HNO_3 is M -

(A) M (B) $\frac{M}{3}$

(C) $\frac{3}{4}M$ (D) $\frac{4}{3}M$

Q.32 A mixture of H_2 and I_2 (vapour) in molecular proportion 2 : 3 was heated at 440° C till the reaction

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

reached equilibrium state. Calculate the percentage of I_2 converted into HI. (K_c at 440° C is 0.02 and x is small compared to unity) –

(A) 10% (B) 5.77 %

(C) 20% (D) 8.3 %

Q.33 5 mL of N HCl, 20 mL of $N/2$ H_2SO_4 and 30 mL of $N/3$ HNO_3 are mixed together and volume made one litre. The normality of the resulting solution is :

(A) $N/5$ (B) $N/10$

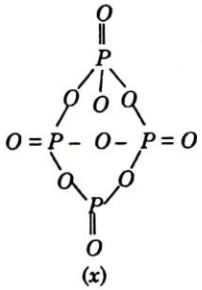
(C) $N/20$ (D) $N/40$

Q.34 If x gm of a metal forms y gram of metal chloride. Equivalent weight of metal is

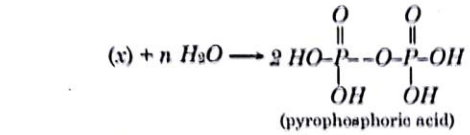
(A) $\frac{x-y}{35.5y}$ (B) $\frac{35.5y}{x-y}$

(C) $\frac{y}{35.5(x-y)}$ (D) None

Q.35 The structure of P_4O_{10} (x) is as follows



(x)

$(x) + n\,H_2O \longrightarrow 2$ 

(pyrophosphoric acid)

What is the value of "n" ?

(A) $n = 6$ (B) $n = 4$

(C) $n = 3$ (D) $n = 5$

Q.36 Dipole moment of p- nitroaniline, when compared to nitrobenzene (X) and aniline (Y) will be

(A) smaller than both (X) and (Y)

(B) greater than both (X) and (Y)

(C) greater than (Y) but smaller than (X)

(D) equal to zero

Q.37 If kinetic energy of a proton is increased nine times the wavelength of the de-Broglie wave associated with it would become

(A) 3 times (B) 9 times

(C) $\frac{1}{3}$ times (D) $\frac{1}{9}$ times.

Q.38 A small particle of mass m moves in such a way that $P.E. = -\frac{1}{2}mkr^2$, where k is a constant and r is the distance of the particle from origin. Assuming Bohr's model of quantization of angular moment and circular orbit, r is directly proportional to -

(A) n^2 (B) n

(C) $\sqrt{n}$ (D) none of these

Q.39 The enthalpy of sublimation of aluminium is 330 kJ/mol. Its Ist, IInd and III^{rd} ionization enthalpies are 580, 1820 and 2740 KJ respectively. How much heat has to be supplied (in kJ) to convert 13.5 gram of aluminium into Al^{3+} ions and electrons at 298 K?

(A) 5470 (B) 3764

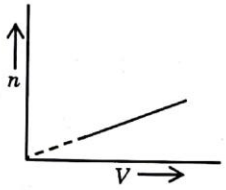
(C) 4105 (D) 2735

Q.40 When one mole of an ideal gas is compressed to half its initial volume and simultaneously heated to twice to its initial temperature, the change in entropy (ΔS) is -

(A) $C_v \ln 2$ (B) $C_p \ln 2$

(C) $R \ln 2$ (D) $(C_v - R) \ln 2$

Q.41 For a given one mole of ideal gas kept at 6.5 atm in a container of capacity 2.463 L. The Avogadro proportionality constant for the hypothesis is (see figure)



(A) 0.406 (B) 2.46

(C) 22.4 (D) none of these

Q.42 K_{sp} of SrF_2 (s) in water is 3.2×10^{-11}. The solubility of SrF_2 (s) in 0.1 (M) $NaCl$ solution is -

(A) 3.2×10^{-9} (M)

(B) 2×10^{-4} (M)

(C) 4×10^{-4} (M)

(D) slightly higher than 2×10^{-4} (M)

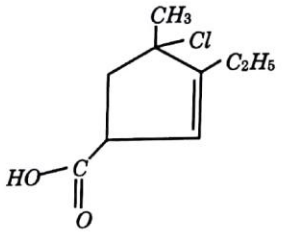
Q.43 The partial pressure of $CH_3OH_{(g)}$, $CO_{(g)}$ and $H_{2(g)}$ in equilibrium mixture for the reaction ;

$CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$ are 2.0, 1.0 and 0.1 atm respectively at 427°C. The value of K_p for decomposition of CH_3OH to CO and H_2 is

(A) 10^2 atm (B) 2×10^2 atm^{-1}

(C) 50 atm^2 (D) 5×10^{-3} atm^2

Q.44 IUPAC name of the following is -



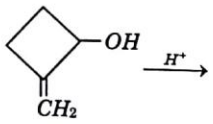
(A) 3-chloro-3-methyl-4-chloro cyclopent - 4-en - carbaldehyde

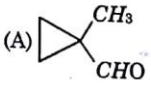
(B) 4-ethyl-3-chloro-3-methyl cyclopent - 5-en carboxylic acid

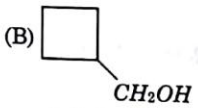
(C) 3-Formyl-5-chloro-5-methyl,-1-ethyl cyclo pentene

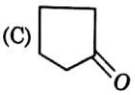
(D) 4-chloro -3- ethyl-4-methyl cyclo pent-2 enecarboxylic acid

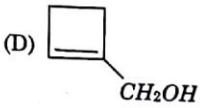
Q.45 The major product of the following isomerisation reaction is -



(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.46 Egyptian pyramids are madeup of limestone contributed by one of the following protozo

(A) Radiolarians (B) Foraminiferans

(C) Vertically (D) All above

Q.47 One of the following fruits is dangerous to be consumed before proper washing as infective stage metacercariae of Fasciolopsis remain attached to it.
(A) Mango (B) Trapa
(C) Apple (D) Coconut

Q.48 In earthworm, the characteristic internal median fold of dorsal wall of the intestine called typhlosole is present in
(A) 5 to 9 segments
(B) 9 to 14 segments
(C) 26 to 35 segments
(D) 15 to last segment

Q.49 Pigmentation of skin is due to the secretion from
(A) Eosinophils (B) Neutrophils
(C) Melanocytes (D) Monocytes

Q.50 A. Diabetes insipidus is marked by excessive urination and too much thirst for water.
R. Anti-diuretic hormone (*ADH*) is secreted by the posterior lobe of pituitary gland.
There are two statements given above. Assertion (*A*) and reason (*R*). Read them and answer accordingly.
(A) If *A* correct and *R* is its explanation
(B) If *A* is correct and *R* is not its explanation.
(C) If *A* is correct and *R* is wrong.
(D) If *A* and *R* both are wrong.

Q.51 Pleurisy is -
(A) Air in pleural cavity
(B) Blood in pleural cavity
(C) Both above
(D) Excessive pleural fluid in pleural cavity

Q.52 Which one of the following statements is correct with regard to the principle of safe blood transfusion?
(A) The recipient's serum should not contain antigens the donor's antibodies.
(B) The donor's red blood corpuscles should not contain antibodies against the recipient's serum.
(C) The recipient's red blood corpuscles should not contain antibodies against the donor's antigen
(D) The recipient's serum should not contain the antibodies against the red blood corpuscles of the donor.

Q.53 In the kidneys the pressure gradient or effective filtration pressure (*E.F.P.*) is determined by
(A) Blood colloidal osmotic pressure
(B) Glomerular hydrostatic pressure
(C) Capsular hydrostatic pressure
(D) All above

Q.54 Which of the following is abundant in Red muscles?
(A) Glucose and Haemoglobin
(B) Myosin and Actin
(C) Myoglobin and Mitochondria
(D) None above

Q.55 A person is having problems with calcium and phosphorous metabolism in his body. Which one of the following glands may not be functioning properly?
(A) Parotid (B) Pancreas
(C) Thyroid (D) Parathyroid

Q.56 Which of the following group of diseases is caused by viruses ?
(A) Mumps, smallpox, herpes, influenza
(B) *AIDS*, diabetes, herpes, tuberculosis
(C) Anthrax, cholera, tetanus, tuberculosis
(D) Cholera, tetanus, smallpox, influenza

Q.57 Gymnosperms are -
(A) Flowering plants
(B) Seed bearing plants
(C) Seedless flowering plants
(D) Fruit bearing plants

Q.58 The main arena of various type of activities of a cell is -

(A) Plasma membrane

(B) Mitochondrion

(C) Cytoplasm

(D) Nucleus

Q.59 Plasmodesmata are -

(A) Lignified cemented layers between the cells

(B) Locomotory structures

(C) Membranes connecting the nucleus with plasmalemma

(D) Connections between the adjacent cells

Q.60 One turn of *B-DNA* contains how many nucleotide pairs ?

(A) 8 (B) 100

(C) 6 (D) 10

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 If $(1-x+x^2)^n = C_0 + C_1x + C_2x^2 + ... + C_{2n}x^{2n}$, then -

$2n.C_{2n} - (2n-1).C_{2n-1} + ... - C_1$ is equal to -

(A) $(n-1)3^{n-1}$ (B) $-n\,3^n$

(C) $(n+1)3^{n+1}$ (D) None of these

Q.62 Adjacent vertices of a rectangle inscribed in a circle are (1, 2) and (3, 4). If a diameter of the circle has equation $2x - y = 2$. Then the centre of the circle is -

(A) $\left(\frac{8}{3}, \frac{10}{3}\right)$ (B) $\left(\frac{7}{3}, \frac{8}{3}\right)$

(C) (2, 2) (D) (1, 0)

Q.63 The number of terms common to the two A.P.'s are

$2 + 5 + 8 + 11 + ... + 98$ and

$3 + 8 + 13 + 18 + 23 + ... + 198$

(A) 33 (B) 40

(C) 7 (D) None of these

Q.64 Equation $ax^3 - 9yx^2 - y^2x + 4y^3 = 0$ represents three straight lines. If two of the lines are perpendicular to each other, then a value of a is -

(A) 5 (B) –5 (C) 4 (D) 3

Q.65 A variable line cuts the lines $x^2 - (a+b)x + ab = 0$ in such a way that intercept between the lines subtends a right angle at origin. The locus of the foot of the perpendicular from origin on the variable line is -

(A) $x^2 + y^2 - (a+b)y + ab = 0$

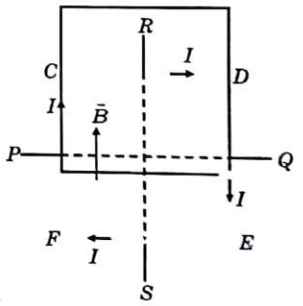
(B) $x^2 + y^2 + (a+b)y - ab = 0$

(C) $x^2 + y^2 + (a+b)y + ab = 0$

(D) $x^2 + y^2 - (a+b)y - ab = 0$

PHYSICS

Q.66 A square loop *CDEF* of wire carrying current I is lying in the plane of paper as shown in figure. The magnetic field $\vec{B}$ is present in the region shown. The loop will tend to rotate :



(A) about *PQ* with *CD* coming out of the page

(B) about *PQ* with *CD* going into the page

(C) about *RS* with *FC* coming out of the page

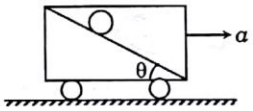
(D) about *RS* with *FC* going into the page

Q.67 Water from a stream is falling on the blades of a turbine at the rate of 100 *kg/sec*. If the height of the stream is 100 *m*, then the power delivered to the turbine is -

(A) 100 *kW* (B) 100 *W*

(C) 10 *kW* (D) 1 *kW*

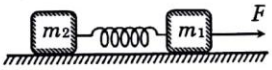
Q.68 Figure shows a smooth inclined plane of inclination θ fixed in a car. A sphere is set in pure rolling on the incline. For what value of 'a' (the acceleration of car in horizontal direction) the sphere will continue pure rolling ?



(A) $g\cos\theta$ (B) $g\sin\theta$

(C) $g\cot\theta$ (D) $g\tan\theta$

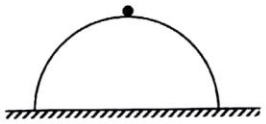
Q.69 Two blocks of masses $m_1 = 1\ kg$ and $m_2 = 2\ kg$ are connected by a non-deformed light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4. What minimum constant force F has to be applied in horizontal direction to the block of mass m_1 in order to shift the other block? ($g = 10\ m/s^2$)



(A) $8\ N$ (B) $15\ N$

(C) $10\ N$ (D) $25\ N$

Q.70 A hemisphere of radius R and of mass $4m$ is free to slide with its base on a smooth horizontal table. A particle of mass m is placed on the top of the hemisphere. The angular velocity of the particle relative to centre of hemisphere at an angular displacement θ when velocity of hemisphere has become v is -

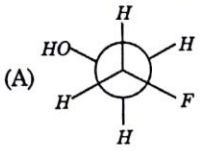


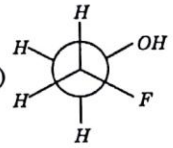
(A) $\frac{5v}{R\cos\theta}$ (B) $\frac{2v}{R\cos\theta}$

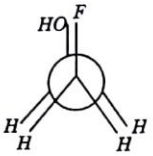
(C) $\frac{3v}{R\sin\theta}$ (D) $\frac{5v}{R\sin\theta}$

CHEMISTRY

Q.71 Find the most stable form -

(A) 

(B) 

(C) 

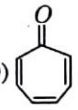
(D) Both (B) & (C)

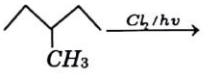
Q.72 Which of the following is aromatic-

(A) 

(B) 

(C) 

(D) 

Q.73 

Total structural monohalide

(A) 4 (B) 3

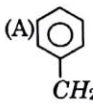
(C) 1 (D) 6

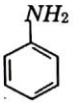
Q.74 Which of the following is best leaving group-

(A) $Cl^{\ominus}$ (B) $-O^{\ominus}-CH_3$

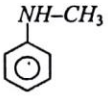
(C) $\ominus NH-CH_3$ (D) $\ominus O-\overset{\overset{O}{\|}}{C}-C_2H_5$

Q.75 Which of the following is least basic-

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.76 At which stage of the cell cycle, RNA polymerase is active

(A) G_1 (B) S

(C) G_2 (D) G_1 & G_2 both

Q.77 In coralloid roots of cycas which of the following is found in symbiotic association & perform fixing of nitrogen

(A) Cynobacteria (B) Mycorrhiza

(C) Franckia (D) Rhizobium

Q.78 In monohybrid cross, Mendel demonstrated that only dominant allele expreses itself in F_1 generation & on selfing of F_1 generation F_2 generation is obtained in which both dominant & recessive alleles express in 3 : 1 ratio. What is reason.

(A) Law of dominance

(B) Law of segregation

(C) Law of principle of unit of factors

(D) None of these

Q.79 Match the two columns and select the correct among options given

Column I	Column II
A. Biomacromolecules of food	i. Alimentary canal and associated gland
B. Human digestive system	ii. Embedded in jawbones
C. Stomach	iii. Outer wall of visceral organs
D. Thecodont	iv. Converted into simple substances
E. Serosa	v. J-shaped bag like structure

Options :

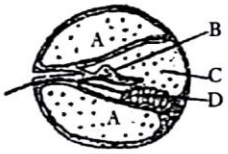
(A) A-ii, B-i, C-v, D-iii, E-iv

(B) A-iv, B-i, C-v, D-ii, E-iii

(C) A-i, B-ii, C-iii, D-iv, E-v

(D) A-i, B-iii, C-ii, D-iv, E-v

Q.80 Given below is diagrammatic cross section of a single loop of human cochlea.



Which one of the following options correctly represents the names of three different parts ?

(A) B : Tectorial membrane, C : Perilymph, D : Secretory cells

(B) C : Endolymph, D : Sensory hair cells, A : Serum

(C) D : Sensory hair cells, A : Endolypmph, B : Tectorial membrane

(D) A : perilymph, B : Tectorial membrane, C : Endolymph

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-3

Stream – SA

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 The number of three digit even numbers which, when divided by 7, yields 2 as a remainder, are -

(A) 64 (B) 65

(C) 128 (D) None of these

Q.2 The number of three digit even natural numbers which on dividing by 3 leaves remainder 1, is -

(A) 155 (B)149

(C) 150 (D) none of these

Q.3 The equation to the circle which touches the axis of y at the origin and passes through (3, 4) is -

(A) $2(x^2 + y^2) - 3x = 0$

(B) $3(x^2 + y^2) - 25x = 0$

(C) $4(x^2 + y^2) - 25y = 0$

(D) $4(x^2 + y^2) - 25x + 10 = 0$

Q.4 Complex numbers z_1 and z_2 lie on the rays $arg(z) = \theta$ and $arg(z) = -\theta$, such that $|z_1| = |z_2| \neq 0$. Further the image of z_2 about y-axis is z_3. Then, a value of $arg(z_1 z_3)$ is equal to -

(A) $\pi/2$ (B) $-\pi/2$

(C) π (D) none of these

Q.5 Q is a point on the auxiliary circle corresponding to the point P of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. If T is the foot of the perpendicular dropped from the focus S onto the tangent to the auxiliary circle at Q then the ΔSPT is -

(A) isosceles (B) equilateral
(C) right angled (D) right isosceles

Q.6 Locus of the point of intersection of the perpendicular tangents of the curve $y^2 + 4y - 6x - 2 = 0$ is

(A) $2x - 1 = 0$ (B) $2x + 3 = 0$
(C) $2y + 3 = 0$ (D) $2x + 5 = 0$

Q.7 Sum of all the odd divisors of 360 is -

(A) 70 (B) 78
(C) 80 (D) 88

Q.8 If $b^2 - 4ac < 0$, then $ax^2 + bx + c$ is always

(A) negative
(B) negative if $a < 0$, positive if $a > 0$
(C) positive
(D) imaginary

Q.9 If the length of sides of a triangle are three consecutive natural numbers such that the largest angle is twice the smallest angle then sides of the triangle are -

(A) 3, 4, 5 (B) 4, 5, 6
(C) 5, 6, 7 (D) 6, 7, 8

Q.10 Equation of the line pair through the origin and perpendicular to the line pair $xy - 3y^2 + y - 2x + 10 = 0$ is

(A) $xy - 3x^2 = 0$ (B) $xy + 3x^2 = 0$
(C) $xy + 3x = 0$ (D) $xy + 3x^3 = 0$

Q.11 A straight line is drawn parallel to the base of a given triangle and its extremities are joined transversely to those of the base. The locus of the point of intersection of the joining lines is –

(A) Straight line (B) Circle
(C) Ellipse (D) None of these

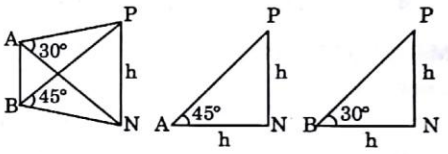
Q.12 $\tan 73° + \tan 62° - \tan 73° \tan 62°$ is equal to -

(A) 1 (B) –1
(C) 0 (D) none of these

Q.13 Value of $\cos 20° \cos 40° \cos 60° \cos 80°$ is -

(A) $\frac{1}{4}$ (B) $\frac{1}{8}$ (C) $\frac{1}{16}$ (D) $\frac{1}{32}$

Q.14 A tower PN stands on a level ground and points A & B are taken at the same level as N with $AB = 10\ m$ and AB at right angles to AN. If $\angle PAN = 45°$ & $\angle PBN = 30°$, then the height of the tower is -



(A) $5\sqrt{2}$ m (B) 37.5 m
(C) 50 m (D) 100 m

Q.15 For $\theta \in \left(-\frac{\pi}{2}, 0\right)$, which of the following option are correct -

(A) $\sin\theta < \sin^3\theta < \cos^2\theta$
(B) $\sin\theta < \sin^3\theta < \cos\theta$
(C) $\sin^3\theta < \cos\theta < \sec\theta$
(D) All of these

PHYSICS

Q.16 When two equal resistors are connected in series, equivalent resistance is R_1 and when they are connected in parallel, then equivalent resistance is R_2 then $\frac{R_1}{R_2}$ is -

(A) 1 (B) 2 (C) 3 (D) 4

Q17 If the length of the filament of a heater is reduced by 10%, the power consumed by the heater will (supply same voltage)

(A) increase by about 9%
(B) increase by about 11%
(C) increase by about 19%
(D) increase by about 10 %

Q.18 A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is -

(A) 2.5 N (B) 0.98 N

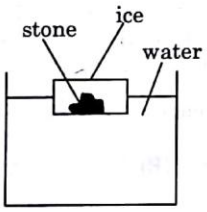
(C) 4.9 N (D) 0.49 N

Q.19 R is the range on a horizontal plane for a shot with the same velocity at two different angles of projection. If h and h' be the greatest heights attained corresponding to these angles of projection, what is R^2 equal to ?

(A) hh' (B) $9hh'$

(C) $16hh'$ (D) 25 hh'

Q.20 A piece of ice with an embedded stone floats on the surface of water in a glass. After the ice has melted, the stone sinks to the bottom of the glass. Compared with the initial water level, what is the change of the water level in the glass, first during the period the ice is melting, and second after the stone sinks to the bottom ?



(A) Remains the same then rises

(B) Remains the same then falls

(C) Remains the same all the way

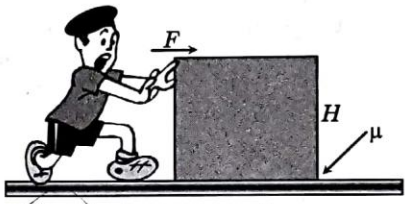
(D) Rises then falls

Q.21 The kinetic energy of a particle in a simple harmonic motion is $\frac{1}{2}av^2$, its potential energy is $\frac{1}{2}bx^2$, where x is the coordinate for the position of the particle and v is its speed. Find the frequency of the motion.

(A) $\frac{1}{2}\sqrt{\frac{a}{b}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{b}{a}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{a}{b}+\frac{b}{a}}$ (D) $\frac{1}{2\pi}\sqrt{ab}$

Q.22 A person exerts a horizontal force F at the upper edge of a box to push the box of uniform mass density, length L, and height H across the floor. The friction coefficient between the box and the floor is μ. If $\mu > \mu_0$, the box will overturn before it slides. Determine the value of μ_0.



(A) $\frac{L}{2H}$ (B) $\frac{L}{H}$

(C) $\frac{H}{L\theta}$ (D) $\frac{\theta L}{H}$

Q.23 A coil is moving towards a straight long wire carrying a steady electric current. The wire and the motion are within the plane of the coil. The force exerted by the wire on the coil is in the direction

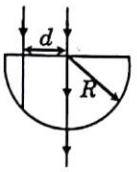
(A) away from the wire

(B) towards the wire

(C) into the paper plane

(D) out of the paper plane

Q.24 As shown, a narrow beam of light is incident onto a semi-circular glass cylinder of radius R. Light can exit the cylinder when the beam is at the center. When the beam is moved parallely to distance d from the central line, no light can exit the cylinder from its lower surface. Find the refractive index of the glass.



(A) $\frac{R}{d}$ (B) $\frac{d}{R}$

(C) $\frac{R}{\sqrt{R^2-d^2}}$ (D) $\frac{\sqrt{R^2-d^2}}{R}$

Q.25 Object-A is dropped from a height h. At the same instant object-B is thrown vertically upward from the ground. Right before they collide in mid-air, the speed of A is twice the speed of B. Determine the height where the collision occurs.

(A) $\frac{2h}{3}$ (B) $\frac{h}{\sqrt{3}}$ (C) $\frac{3h}{4}$ (D) $\frac{h}{2}$

Q.26 An object of mass m is placed on a horizontal floor. The static friction coefficient between the object and the floor is $\mu = 1$. Find the minimum force that can move the object.

(A) $\frac{mg}{2}$ (B) $\frac{mg}{\sqrt{2}}$ (C) $\sqrt{2}\,mg$ (D) $2mg$

Q.27 A uniform chain of mass m and length L is originally placed mid-way on the top of a fixed smooth double-sided wedge (Figure-A). The length of each side of the wedge is L. It is then given a slight push. Find the kinetic energy of the chain when the whole chain has just slid to the left side of the wedge (Figure-B)

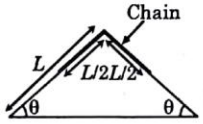


Figure (A)

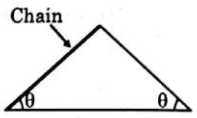
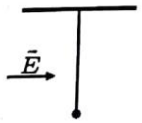


Figure (B)

(A) $mgL\sin\theta$ (B) $\frac{mgL\sin\theta}{2}$

(C) $\frac{mgL\sin\theta}{4}$ (D) $\frac{mgL\sin\theta}{8}$

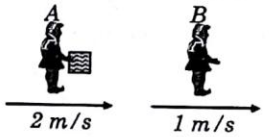
Q.28 A simple pendulum is made of a small ball of mass m carrying charge q attached by a thin wire to the ceiling. Its original simple harmonic oscillation frequency is ω_0. After a uniform electric field E is applied horizontally to the pendulum, its frequency becomes $2\omega_0$. Find the strength of the electric field.



(A) $\sqrt{15}\,mg/q$ (B) $\sqrt{3}\,mg/q$

(C) mg/q (D) mg/q

Q.29 Two astronauts, A and B, both with mass of 60 kg, are moving along a straight line in the same direction in a "weightless spaceship. Relative to the spaceship the speed of A is 2 m/s and that of B is 1 m/s. A is carrying a bag of mass 5 kg with him. To avoid collision with B, A throws the bag with a speed v relative to the spaceship towards B and B catches it. Find the minimum value of v.



(A) 7.8 m/s (B) 26.0 m/s

(C) 14.0 m/s (D) 9.2 m/s

Q.30 Three point charges, each with charge Q, are placed on the apexes of an equilateral triangle of length R. The potential energy of the system is then $\frac{K}{4\pi\varepsilon_0}\frac{Q^2}{R}$, where K is -

(A) 2 (B) 3 (C) 6 (D) 1

CHEMISTRY

Q31 The equivalent weight of $K_4[Fe(CN)_6]$ in the given reaction is

$K_4[Fe(CN)_6] \xrightarrow{[O]} Fe^{3+} + NO_3^- + CO_2$

(A) $M/20$ (B) $M/1$ (C) $M/60$ (D) $M/61$

Q.32 10^{-2} moles of Fe_3O_4 is treated with excess of KI solution in presence of dilute H_2SO_4, the products are Fe^{2+} and I_2 (g). What volume of 0.1 (M) $Na_2S_2O_3$ will be needed to reduce the liberated I_2 (g) ?

(A) 50 ml (B) 100 ml

(C) 200 ml (D) 400 ml

Q.33 At room temperature ratio of pressures of CH_4 and CO_2 kept in two separate containers of equal volume is 3 : 5. Then two containers have equal number of -

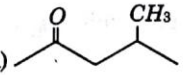
(A) moles (B) electrons

(C) atoms (D) molecules

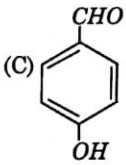
Q.34 The solubility of substance "*X*" in pure ethanol is 0.1 *gm/lit* and in water is 0.01 *gm/lit*. To dissolve 11 *gm* of dry "*X*" we are adding 20 *ml* of fresh 50% (*V/V*) ethanol solution in each time on "*X*". How many times we are to add this ethanol solution to dissolve "*X*" ?

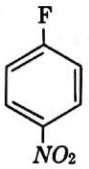
(A) 100 (B) 10^6 (C) 10^3 (D) 10^4

Q.35 In which of the following species intramolecular *H*-bonding can be exhibited in the aqueous solution ?

(A) 

(B) 

(C) 

(D) 

Q.36 You have given two species–*NOF* and NO_2F and two dipole moments 1.81 *D* and 0.47 *D* -

(A) 1.81 *D* for NO_2F and 0.47 *D* for *NOF*

(B) 0.47 *D* for NO_2F and 1.81 *D* for *NOF* because NO_2F is linear but *NOF* is non linear molecule

(C) 0.47 *D* for NO_2F because bond moments of *NO* bond and *NF* bonds are oriented in the opposite direction

(D) 0.47 *D* for NO_2F and 1.81 *D* for *NOF*

Q.37 The difference of number of sigma bonds and π bonds in 1, 3, 5-tricyanobenzene is -

(A) 5 (B) 3 (C) 6 (D) zero

Q.38 For a hydrogenic ion kinetic energy of electron in its 3rd excited state is found to be 54.4 *eV*. Then series limit $\left(\frac{1}{\lambda}\right)$ for Balmer series, for this ion, is

(A) $109678 \times 16\ cm^{-1}$ (B) $109678/16\ cm^{-1}$

(C) $109678 \times 4\ cm^{-1}$ (D) $109678 \times 64\ cm^{-1}$

Q.39 Which of the following statement is correct ?

(A) Bi^{5+} salts act as good oxidising agents

(B) Sn^{2+} salts act as good Reducing agents

(C) Tl^{3+} salts act as good oxidising agents

(D) All of these

Q.40 The critical constants *Pc* & *Tc* for methane are 45 *atm* and 189 *K*. The correct statement is -

(A) $V_C = 2.4\ L$ (B) $b = 0.04\ L/mol$

(C) $V_C = 0.8\ L$ (D) $b = 0.8\ L/mol$

Q.41 Regarding the solubility of gas which of the following is/are incorrect ?

(A) Higher the value of Henry's law constant at a given pressure, the lower is the solubility of gas in the liquid

(B) Solubility of a gas in a liquid decreases with increase in temperature and pressure

(C) The dissolution of gas in a liquid is exothermic process

(D) All of the above are correct

Q.42 100 *ml* solution (*I*) of buffer containing 0.1(*M*) *HA* and 0.2 (*M*) A^-, is mixed with another solution (*II*) of 100 *ml* containing 0.2(*M*) *HA* and 0.3(*M*) A^- . After mixing what is the *pH* of resulting solution ?

Given pK_a of *HA* = 5

(A) $5 - \log 5/3$ (B) $5 + \log 5/3$

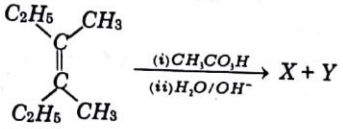
(C) $5 + \log 2/5$ (D) $5 - \log 5/2$

Q.43 The reaction,

$N_2O_5\ (g) \rightleftharpoons 2\ NO_2\ (g) + \frac{1}{2}\ O_2\ (g)$, is started with initial pressure of $N_2O_5\ (g)$ equal to 600 torr. What fraction of $N_2O_5\ (g)$ decomposed when total pressure of the system is 960 torr ?

(A) 0.05 (B) 0.1 (C) 0.2 (D) 0.4

Q.44 In reaction-



Which of the following is incorrect about the reaction ?

(A) X and Y are enantiomeric pair

(B) One of the product is meso

(C) Both X and Y are optically active

(D) Given reaction is an example of anti hydroxylation about double bond

Q.45. For the oxidation of glucose, $\Delta_r H^\circ = -2808$ kJ/mol and $\Delta_r G^\circ = -3000\ kJ/mol$ 25% of energy of the is oxidised for muscle work. Therefore, in order to climb a hill of height 500 metres, how many gm of glucose is required for a man of mass 100 kg ? [$g = 10\ m/s^2$]

(A) 100 gm (B) 180 gm

(C) 200 gm (D) 120 gm

BIOLOGY

Q.46 The amount of CO_2 plant is greater at night than during the day because -

(A) The rate of respiration is higher at night

(B) More CO_2 is produced because it is colder during the night

(C) Photosynthesis during the day uses up some of the CO_2 produced by respiration

(D) More glucose is available for respiration during the night

Q.47 Fruits kept in refrigerator maintain their flovour and taste for longer period due to -

(A) Non-availability of O_2

(B) Presence of excess CO_2

(C) Slowing down of respiration

(D) Presence of excess Moisture

Q.48 Movement of *WBCs* out of capillaries is called -

(A) Translocation (B) Phagocytosis

(C) Diapedesis (D) Pinocytosis

Q.49 Which of the following mechanism would account for increased urine production ?

(A) Decreased amount of antidiuretic hormone secretion

(B) Increased aldosterone production ?

(C) Increased blood pressure

(D) The proximal tubules reabsorbing more water

Q.50 Estimate the order of the speed of propagation of an action potential or nerve impulse -

(A) nm/s (B) micron/s

(C) cm/s (D) m/s

Q.51 Conn's disease is caused due to -

(A) *ADH* (B) *ACTH*

(C) Aldosterone (D) None of these

Q.52 A plant cell having a celluosic wall, a thin of cytoplasm with a large vacuoble but lacks nucleus, mitrochondria, plastid etc. and still living. It is a part of complex permanent tissue. The cell is -

(A) companion cell

(B) sieve cell

(C) trachied

(D) sclerenchyma fibre

Q.53 A monocot stem with secondary growth is -
(A) Lilium (B) Cocos
(C) Yucca (D) Asparagus

Q.54 A plant cell has 12 chromosomes at the end of mitosis. How many chromosomes would it have in the *G* phase of its next cell cycle -
(A) 6 (B) 8
(C) 12 (D) 24

Q.55 During photosynthesis O_2 liberates through -
(A) CO_2 (B) H_2O
(C) ATP (D) $NADP^+$

Q.56 Shedding of leaves, flowers and fruits due to change in hormone balance in plants is -
(A) Senescence (B) Abscission
(C) Photoperiodism (D) Vemalisation

Q.57 Which of the following statements is not correct -
(A) All enzymes are proteins
(B) Al enzymes are biocatalysts
(C) All proteins are enzymes
(D) All enzymes are thermolabile

Q.58 During inspiration, the diaphragm
(A) Expands
(B) Shows no change
(C) Contracts and flattens
(D) Relaxes to become done-shaped

Q.59 'Heart of Heart' is -
(A) *SA* node (B) *AV* node
(C) Bundle of H is (D) Purkinje fibres

Q.60 Uricotelism is found in -
(A) Birds, reptile and insects
(B) Frogs and toads
(C) Mammals and birds
(D) Fishes and fresh water proozoans

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 If $f(x) = 27x^3 + \frac{1}{x^3}$ and α, β are the roots of $3x + \frac{1}{x} = 2$, then $f(\alpha)$ is equal to -
(A) 10 (B) -10
(C) 3 (D) None of these

Q.62 A circle touches the hypotenuse of a right angled triangle at its middle point and passes through the middle point of the shorter side. If 3 unit and 4 unit be the length of the sides and '*r*' be the radius of the circle, then the value of '*r*' is -
(A) $\frac{1}{6}$ (B) $\frac{3}{5}$
(C) $\frac{5}{3}$ (D) None of these

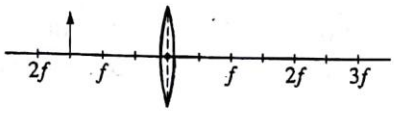
Q63 The sum of the roots of the equation $2^{33x-2} + 2^{11x+2} = 2^{22x+1} + 1$ is -
(A) $\frac{11}{2}$ (B) $-\frac{2}{11}$
(C) $\frac{2}{11}$ (D) None of these

Q.64 N_1 & N_2 are no. of distinct terms in expansion of $(a + b + c + d)^n$ and $(a + b + c)^n$ respectively. Given that N_1/N_2 is a natural number more than 9, then least value of '*n*' is –
(A) 27 (B) 26
(C) 25 (D) 24

Q.65 No. of terms with integral coefficients in expansion of $(5^{1/3} - 3^{1/4}\, x^2)^{296}$ is –
(A) 26 (B) 25
(C) 24 (D) 27

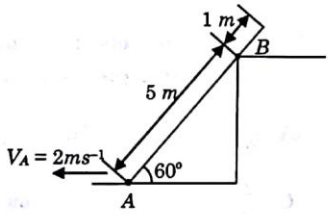
PHYSICS

Q66 An object is placed at a distance of 1.5 f from a converging lens of focal length f, as shown below. What type of image is formed and what is its size -



Type	Size
(A) Virtual	Larger
(B) Virtual	Small size
(C) Virtual	Smaller
(D) Real	Larger

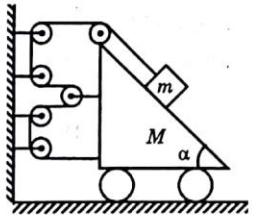
Q.67 Velocity of point A on the rod is 2 m/s (leftward) at the instant shown in the fig. The velocity of the point B on the rod at this instant is -



(A) $\frac{2}{\sqrt{3}}$ m/s (B) 1 m/s

(C) $\frac{1}{2\sqrt{3}}$ m/s (D) $\frac{\sqrt{3}}{2}$ m/s

Q.68 If the acceleration of wedge in the figure shown is "a" m/s^2 towards left, then at this instant acceleration of the block (magnitude only) would be -



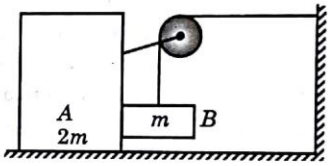
(A) $4a$ m/s^2

(B) $a\sqrt{17-8\cos\alpha}$ m/s^2

(C) $\sqrt{17a}$ m/s^2

(D) $\sqrt{17}\left[\cos\left(\frac{\alpha}{2}\right)\right]a$ m/s^2

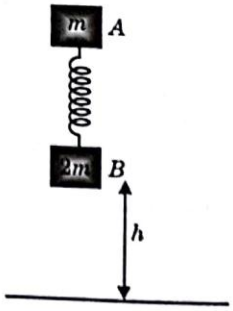
Q.69 In the figure all the surfaces are frictionless while pulley and string are massless. Mass of block A is $2m$ and that of block B is m. Acceleration of block B immediately after system is released from rest in vertical direction only -



(A) $g/2$ (B) g

(C) $g/3$ (D) none of these

Q.70 From what minimum height h must the system be released when spring is unstretched so that after perfectly inelastic collision (e = 0) with ground, B may be lifted off the ground (spring constant = k) ?

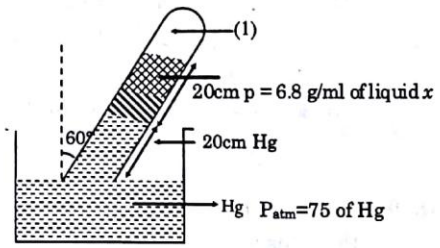


(A) $mg/(4k)$ (B) $4mg/k$

(C) $mg/(2k)$ (D) none of these

CHEMISTRY

Q.71 Pressure of the gas in column (A) is –



(A) 60 cm of Hg (B) 55 cm of Hg

(C) 50 cm of Hg (D) 45 cm of Hg

Q.72 A certain mass of gas is expanded from (1 L, 10 atm) to (4 L, 5 atm) against a constant external pressure of 1 atm. If initial temperature of gas is 300 K and the heat capacity of process is 50 $J/°C$. Then the enthalpy change during the process is (I $L\ atm \simeq 100\ J$)

(A) $\Delta H = 15\ kJ$ (B) $\Delta H = 15.7\ kJ$

(C) $\Delta H = 14.4\ kJ$ (D) $\Delta H = 14.7\ kJ$

Q.73 The value of k_p for the reaction at 27°C

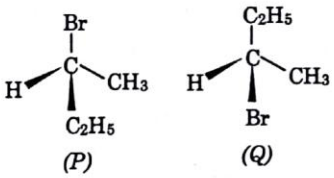
$$Br_2(\ell) + Cl_2(g) \rightleftharpoons 2BrCl(g)$$

is '1 atm.' At equilibrium in a closed container partial pressure of BrCl gas is 0.1 atm and at this temperature the vapour pressure of $Br_2(\ell)$ is also 0.1 atm . Then what will be minimum moles of $Br_2(\ell)$ to be added to 1 mole of Cl_2, initially, to get above equilibrium situation -

(A) $\frac{10}{6}$ moles (B) $\frac{5}{6}$ moles

(C) $\frac{15}{6}$ (D) 2 moles

Q.74 The addition of HBr to 1-butene gives a mixture of products P, Q and R.



$CH_3–CH_2–CH_2–CH_2–Br$

(R)

The mixture consists of -

(A) P and Q as major and R as minor products

(B) Q as major, P and R as minor products

(C) Q as minor, P and R as major products

(D) P and Q as minor and R as major products

Q.75 Which of the following products in the given reactions is wrong ?

(A) Benzene+$Cl_2 \xrightarrow{AlCl_3}$ Benzene hexachloride

(B) Benzene(*excess*) + $CH_3Cl \xrightarrow{AlCl_3}$ Toluene

(C) Benzene + $CH_3COCl \xrightarrow{AlCl_3}$ Methyl phenyl ketone

(D) Toluene $\xrightarrow{KMnO_4/NaOH}$ Benzoic acid

BIOLOGY

Q.76 Select the correct constituents of protein -

(A) Carbon, hydrogen, oxygen and nitrogen

(B) Carbon, hydrogen, nitrogen and sulphur

(C) Carbon, hydrogen, nitrogen, oxygen and sulphur

(D) Carbon, hydrogen and oxygen

Q.77 In G_1-phase of cell cycle, what would be the change in *DNA* content of the cell ?

(A) *DNA* content increases to double

(B) *DNA* content gets reduced

(C) Four fold increase of *DNA* content

(D) No change in *DNA* content

Q.78 Which of the following event distinguishes prophase-I of meiosis from prophase of mitosis ?

(A) Nuclear membrane breaks down

(B) Chromosomes become visible

(C) Homologous chromosomes pair up

(D) Spindle forms

Q.79 When a plant cell is placed in pure water, it -

(A) Expands until the osmotic pressure reaches that of water

(B) Becomes less turgid until the osmotic potential reaches that of pure water

(C) Becomes more turgid until the pressure potential of cell reaches its osmotic potential

(D) Becomes more turgid until the osmotic potential reaches that of pure water

Q.80 If there is mutation in cytochrome system then this will -

(A) Inhibit the movement of electrons from *PS*-II to *PS*-I

(B) Inhibit the movement of electrons from *PS*-I to *PS*-II

(C) Inhibit the photolysis of water

(D) Promote *ATP* formation

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-4

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 If $\pi < \theta < 2\pi$, then the equation

$\text{cosec}\ \theta = \log_{1/3}\left(\frac{2-3x}{x}\right)$ is possible for the values of x in the interval -

(A) $\left(0, \frac{2}{3}\right)$ (B) $\left(0, \frac{1}{3}\right]$

(C) $(-\infty, 0) \cup \left(\frac{1}{3}, \frac{2}{3}\right)$ (D) none of these

Q.2 Greatest integer less than or equal to $\log_{\cos 13^\circ}(43) \cdot \log_{\pi} \text{cosec}\theta \cdot \log_{\text{cosec}\theta} \cos 13^\circ \cdot \log_{2\pi}$ is

(A) 3 (B) 4

(C) 5 (D) 6

Q.3 The square of any odd number is of the form -

(A) $8n + 1$ (B) $2n + 1$

(C) $4n + 1$ (D) all of these

Q.4 The root of the equation

$z^5 + z^4 + z^3 + z^2 + z + 1 = 0$

having the least positive argument is -

(A) $\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}$ (B) $\cos\frac{\pi}{5} + i\sin\frac{\pi}{5}$

(C) $\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}$ (D) $\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}$

Q.5 The ratio in which the point where tangent at (2, 1) of the ellipse $x^2 + 2y^2 = 6$ meet the major axis divides it foci is -

(A) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ externally

(B) 2 : 1 externally

(C) 3 : 1 externally

(D) $2\sqrt{3}$: 1 externally

Q.6 If ${}^{n}C_r$ is divisible by n then possible set of (n, r) is -

(A) (12, 8) (B) (20, 12)

(C) (30, 15) (D) (32, 15)

Q.7 A man is dealt five cards from an ordinary pack of 52 playing cards. Number of ways in which he can be dealt with a pair of aces and other three cards of different denominations, is -

(A) 103776 (B) 84480

(C) 84840 (D) 48840

Q.8 In a ΔABC, if $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$, and the side $a = 2$, then area of the triangle is -

(A) 1 (B) 2

(C) $\frac{\sqrt{3}}{2}$ (D) $\sqrt{3}$

Q.9 The equation $axy + bx + cy + d = 0$ represents a pair of straight lines, then -

(A) $bc = ad$

(B) the line are parallel

(C) the lines can not be coincident

(D) the lines are coincident

Q.10 If the vertices A & B of triangle ABC are given by (2, 5) & (4, –11) respectively and C moves along the line $L = 9x + 7y + 4 = 0$, then the locus of the centroid of the triangle ABC is -

(A) a circle

(B) any straight line

(C) a line parallel to L

(D) a line perpendicular to L

Q.11 The expression

$(1 + \tan x + \tan^2 x)(1 - \cot x + \cot^2 x)$

has the positive values then -

(A) $0 \le x \le \frac{\pi}{2}$

(B) $0 \le x \le \pi$

(C) for all $x \in R - n\frac{\pi}{2}$, $n \in Z$

(D) $x \ge 0$

Q.12 If $\cos A = \frac{3}{4}$ then $64 \sin\frac{A}{2} \cdot \sin\frac{5A}{2}$ equals

(A) 49 (B) 32

(C) 21 (D) 22

Q.13 If $\sec\theta + \tan\theta = 1$, then one root of equation

$a(b-c)x^2 + b(c-a)x + c(a-b) = 0$ is

(A) $\tan\theta$ (B) $\sec\theta$

(C) $\cot\theta$ (D) $\sin\theta$

Q.14 The locus of z which satisfies the inequality $\log_{0.3}|z-1| > \log_{0.3}|z-i|$ is given by

(A) $x + y < 0$ (B) $x + y > 0$

(C) $x - y > 0$ (D) $x - y < 0$

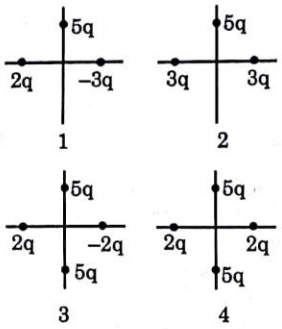
Q.15 Which of the following locus of z on the complex plane represents a pair of straight lines ?

(A) $\text{Re}\, z^2 = 0$ (B) $\text{Im}\, z^2 = 1$

(C) $|z| + z = 0$ (D) $|z-1| = |z-i|$

PHYSICS

Q.16 The diagrams below depict four different charge distributions. The charge particles are all the same distance from the origin. The electric field at the origin :



(A) is greatest for situation 4
(B) is greatest for situation 3
(C) is zero for situation 4
(D) is downward for situation 1

Q.17 n identical light bulbs, each designed to draw P power from a certain voltage supply, are joined in series across that supply. The total power which they will draw is –

(A) nP (B) P
(C) P/n (D) P/n^2

Q.18 A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is -

(A) 2.5 N (B) 0.98 N
(C) 4.9 N (D) 0.49 N

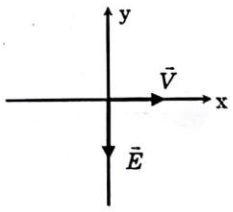
Q.19 An object is placed 30 cm to the left of a diverging lens whose focal length is of magnitude 20 cm. Which one of the following correctly states the nature and position of the virtual image formed?

	Nature of image	Distance form lens
(A)	Inverted enlarged	60 cm to the left
(B)	Erect, diminished	12 cm to the left
(C)	Inverted, enlarged	60 cm to the left
(D)	Erect, diminished	12 cm to the right

Q.20 $^{235}_{92}U$ atom disintegrates to $^{207}_{82}Pb$ with a half-life of 10^9 years. In the process it emits 7 alpha particles and $n\beta^-$ particles. Here n is -

(A) 7 (B) 3
(C) 4 (D) 14

Q.21 An electron is traveling in the positive x direction. A uniform electric field E is in the negative y-direction. If a uniform magnetic field with the appropriate magnitude and direction also exists in the region, the total force on the electron will be *zero*. The appropriate direction for the magnetic field is :

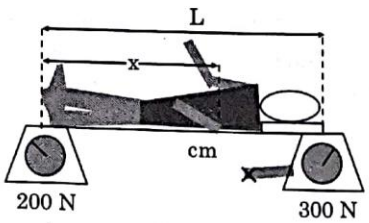


(A) the positive y-direction
(B) the negative y direction
(C) into the page
(D) out of the page

Q.22 If a simple harmonic motion is represented by $\frac{d^2x}{dt^2}+\alpha x = 0$, its time period is –

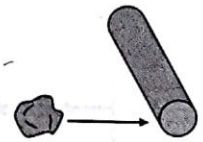
(A) $\frac{2\pi}{\alpha}$ (B) $\frac{2\pi}{\sqrt{\alpha}}$
(C) $2\pi\alpha$ (D) $2\pi\sqrt{\alpha}$

Q.23 A student lies on a rigid platform of negligible mass, which is in turn placed upon two spring scales as shown. The scale on the left, at $x = 0$, reads 200 Newton, and the scale on the right, at $x = L$, reads 300 Newton. At what position x is the centre of mass located ?



(A) $\frac{1}{2}$L (B) $\frac{2}{5}$L (C) $\frac{3}{5}$L (D) $\frac{4}{5}$L

Q.24 An asteroid traveling through space collides with one end of a long, cylindrical satellite as shown below, and sticks to the satellite. Which of the following is true of the isolated asteroid-satellite system in this collision?



(A) Kinetic energy K is conserved

(B) Total Energy E is conserved, but angular momentum L is not conserved

(C) Angular momentum L is conserved, but linear momentum p is not conserved

(D) Angular momentum L is conserved, and total energy E is conserved

Q.25 A soccer ball is rolling along a field with a speed + $V_{initial}$ when a student runs up and kicks the ball in the same direction that it was traveling so that it now has a greater speed in the same direction, + V_{final}. Your physics teacher wants you to take measurements that will allow you to calculate a rough estimate of the impulse applied to the ball by the student's foot.

Which measurements would you want to make so that you could calculate this impulse?

(I) The distance and times the ball traveled both before and after the kick

(II) The mass applied to the ball

(III) The forces applied to the ball

(IV) The time that the foot and the ball were in contact

(A) I and II (B) I and III

(C) I and IV (D) II and III

Q.26 One end of a conducting rod is maintained at temperature 50°C and at the other end, ice is melting at 0°C. The rate of melting of ice is doubled if:

(A) The temperature is made 200°C and the area of cross-section of the rod is doubled

(B) The temperature is made 100°C and length of rod is made four times

(C) Area of cross-section of rod is halved and length is doubled

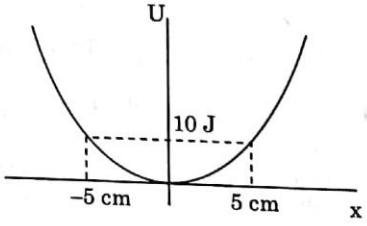
(D) The temperature is made 100° and the area of cross-section of rod and length both are doubled

Q.27 A heat engine is 20% efficient. If the engine does 500 J of work every second, how much heat does the engine exhaust every sound?

(A) 2000 J (B) 2500 J

(C) 100 J (D) 400 J

Q.28 A mass experiences a potential energy U that varies with distance x as shown in the graph below. The mass is released from position $x = 0$ with 10 J of kinetic energy. Which of the following describes the long-term motion of the mass?



(A) The mass eventually comes to rest at $x = 0$

(B) The mass slows down with constant acceleration, stopping at $x = 5$ cm.

(C) The mass speeds up with constant acceleration.

(D) The mass oscillates, never getting farther than 5 cm from $x = 0$

Q.29 What should be the stress (F/A) in a stretched wire of a material whose young modulus is Y for the speed of longitudinal waves to equal 30 times the speed of transverse waves.

(A) $\frac{Y}{30}$ (B) $\frac{Y}{900}$ (C) $30\,Y$ (D) $\frac{Y}{90}$

Q.30 A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between the two bridges when a mass of 9 *kg* is suspended from the wire. When this mass is replaced by a mass M, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value of M is -

(A) 25 *kg* (B) 5 *kg*

(C) 2.7 *kg* (D) 1/25 *kg*

CHEMISTRY

Q.31 A mixture of CH_4 and C_2H_2 occupied a certain volume at a total pressure equal to 63 *torr*. The same gas mixture was burnt to CO_2 and H_2O (ℓ). The CO_2 (g) alone was collected in the same volume and at the same temperature, the pressure was found to be 69 *torr*.
What was the mole fraction of CH_4 in the original gas mixture ?

(A) $\frac{19}{21}$ (B) $\frac{19}{20}$

(C) $\frac{17}{18}$ (D) $\frac{15}{16}$

Q.32 For 118% labelled oleum if the no. of moles of H_2SO_4 and free SO_3 be x & y respectively, the values of $\left(\frac{x+y}{x-y}\right)$ is approximately -

(A) –1.21 (B) – 1.51

(C) 1.51 (D) 1.21

Q.33 For the reaction : $Fe_2S_3 \longrightarrow FeSO_4 + SO_2$
The equivalent mass of Fe_2S_3 is
(M is the mol *wt* of Fe_2S_3)

(A) $\frac{M}{4}$ (B) $\frac{M}{16}$ (C) $\frac{M}{22}$ (D) $\frac{M}{20}$

Q.34 The average atomic mass of a mixture containing 79 mole % of ^{24}Mg remaining 21 mole % of ^{25}Mg and ^{26}Mg is 24.31 %. Mole of ^{26}Mg is -

(A) 5 (B) 20 (C) 10 (D) 15

Q.35 Which of the following ions have zero value of magnetic moment ?

(A) Sc^{3+} (B) Ti^{4+} (C) Zn^{2+} (D) None

Q.36 Maleic acid is stronger than fumaric acid because-

(A) Fumaric acid shows intermolecular H-bonding

(B) Fumaric acid shows intramolecular H-bonding

(C) Maleic acid is dibasic acid

(D) Maleic acid shows chelation or intramolecular H-bonding

Q.37 The difference between the incident energy and threshold energy for an electron in a photoelectric effect experiment is $5eV$. The de Broglie wavelength of the electron is -

(A) $\frac{6.6\times10^{-9}}{\sqrt{1456}}m$ (B) $\frac{6.6\times10^{-9}}{\sqrt{145.6}}m$

(C) $\frac{6.6\times10^{-9}}{\sqrt{1664}}$ (D) $\frac{6.6\times10^{-9}}{\sqrt{166.4}}m$

Q.38 An element of atomic mass 40 has 2, 8, 8, 2 as the electronic configuration. Which one of the following statement regarding this element is not correct ?

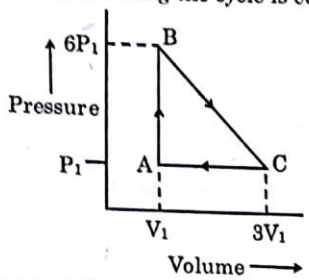
(A) It forms an basic oxide

(B) It belongs to II A group

(C) It belongs to IV period

(D) It forms an acidic oxide

Q.39 An ideal gas is taken around the cycle $ABCA$ as shown in P-V diagram. The net work done during the cycle is equal to -



(A) $12\ P_1V_1$ (B) $6\ P_1V_1$
(C) $5\ P_1V_1$ (D) P_1V_1

Q.40 The caloriefic value $H_2(g)$ at STP is 12.78 KJ/L hence approximate standard enthalpy of formation of $H_2O(\ell)$ is -

(A) $-143\ KJ$ (B) $-286\ KJ$
(C) Zero (D) $+286\ KJ$

Q.41 The standard enthalpy and entropy changes for the reaction in equilibrium for the forward reaction are given below.

$CO\ (g) + H_2O\ (g) \rightleftharpoons CO_2\ (g) + H_2\ (g)$

$\Delta H°_{300K} = -41.16\ kJ\ mol^{-1}$

$\Delta S°_{300K} = -4.24 \times 10^{-2}\ kJ\ mol^{-1}$

$\Delta H°_{1200K} = -32.93\ kJ\ mol^{-1}$

Then, the incorrect statement is -

(A) The reaction proceeds in the forward direction at 300 K

(B) At 1200 K, reaction proceeds in the reverse direction

(C) At 1200 K, $Kp > 1$

(D) At 300 K, the products will be favoured more than reactants at equilibrium

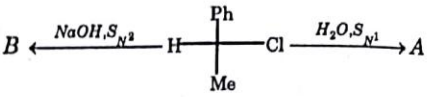
Q.42 Fixed volume of 0.1 M benzoic acid ($pK_a = 4.2$) solution is added into 0.2 M sodium benzoate solution and formed a 300 ml, resultant acidic buffer solution. If pH of this buffer solution is 4.5 then find added volume of benzoic acid -

(A) 100 ml (B) 150 ml
(C) 200 ml (D) None of these

Q.43 How many optical active alkyl groups are possible by pentane -

(A) 4 (B) 3 (C) 2 (D) 0

Q.44

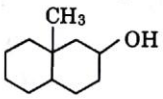


I : Formation of A has proceeded with racemisation

II: Formation of B has proceeded with inversion. Select the correct statement:

(A) I and II both are correct
(B) only I is correct
(C) only II is correct
(D) none is correct

Q.45 Number of stereocenter and stereosiomers of the given compound -



will be -

(A) 1 and 2 (B) 2 and 4
(C) 3 and 8 (D) 3 and 6

BIOLOGY

Q.46 Which of these sets in incorrect?

(A) Plasmodium falciparum, malaria, relapse, mosquito

(B) Trypanosomagambiense, glossina, sleeping, sickness, winter bottom's sign

(C) Wuchereriabancrofti, elephantiasis, microfilariae, mosquito

(D) Entamoebahistolytica, dysentery, quadrinucleate cyst, coton

Q.47 Many sponges are larger than fishes yet they do not have respiratory organs. This explains that-

(A) Sponges respires anaerobically

(B) Sponges lead stationary life thus oxygen requirement is less

(C) Sponges have a porous body through which water flows bathing every cell

(D) Respiratory organs are useless in water

Q.48 The type of tissue lining the nasal passage, bronchioles and fallopian tubes is-
(A) Columnar ciliated epithelium
(B) Cuboidal epithelium
(C) Neurosensory epithelium
(D) Germinal epithelium
(E) Stratified columnar epithelium

Q.49 Regulation of body temperature in a homeotherm during high environmental temperature would involve –
(A) Dilation of blood vessels of skin
(B) Constriction of blood vessels of skin
(C) No change in blood vessels of skin
(D) Decreased flow of blood without any change in blood vessels of skin

Q.50 A person is suffering from long standing constipation. It is likely that-
(A) His intestinal bacteria will get killed by poisonous gases produced by accumulated faces
(B) He will suffer from piles
(C) He will feel severe pain in the stomach due to accumulated faces
(D) He will suffer from vitamin B deficiency as its absorption is inhibited

Q.51 The sum of *IRV*, *ERV*, *TV* is-
(A) Vital capacity
(B) Total lung capacity
(C) Expiratory reserve volume
(D) Aspiratory reserve volume

Q.52 Match the different types of heart given in Column I with their respective examples given in Column II ; choose the answer showing correct combinations of alphabets of two columns-

	Column-I (Hearts)		**Column-II (Examples)**
(A)	Myogenic heart	(p)	Limulus
(B)	Neurogenic heart	(q)	Mollusca
(C)	Branchial heart	(r)	Man
(D)	Pulmonary heart	(s)	Herdmania
		(t)	Shark

(A) A = q, B = p, C = t, D = r
(B) A = p, B = q, C = r, D = t
(C) A = q, B = s, C = t, D = p
(D) A = s, B = p, C = r, D = t

Q.53 Cartilaginous fishes protect themselves in hypertonic sea water by
(A) Accumulating excess of urea in their bodies
(B) Accumulating excess of uric acid in their bodies
(C) Secreting excess of urea in the sea
(D) Accumulating excess of ammonia in body

Q.54 One of the examples of the action of the autonomous nervous system is :
(A) Knee – jerk response
(B) Papillary reflex
(C) Swallowing of food
(D) Peristalsis of the intestines

Q.55 For taste, what type of receptors are there in our body?
(A) Gustatoreeptor (B) Tangoreceptor
(C) Photoreceptor (D) Olfactoreceptor

Q.56 The protein coat of a virus is known as -
(A) Nucleoid (B) Capsid
(C) Capsomere (D) Outer envelope

Q.57 Which of the following pteridophytes is heterosporous in nature ?
(A) *Selaginella* and *Salvinia*
(B) *Adiantum* and *Equisetum*
(C) *Psilotum* and *Lycopodium*
(D) *Adiantum* and *Psilotum*

Q.58 Which enzyme joints DNA fragments ?
(A) DNA ligase
(B) DNA polymerase
(C) DNA gyrase
(D) Topoisomerase

Q.59 When DNA replication starts -

(A) The leading strand produces Okazaki fragments

(B) The hydrogen bonds between the nucleotides of two strands break

(C) The phosphodiester bonds between the adjacent nucleotides break

(D) The bonds between the nitrogen base and deoxyribose sugar break

Q.60 Name the most abundant protein in animal world -

(A) RUBISCO

(B) Carboxylase-oxygenase

(C) Collagen

(D) Cellulose

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 Equation of a straight line meeting the circle $x^2 + y^2 = 100$ in two points, each point at a distance of 4 from the point (8, 6) on the circle is -

(A) $4x + 3y - 50 = 0$

(B) $4x + 3y - 100 = 0$

(C) $4x + 3y - 46 = 0$

(D) none of these

Q.62 If the distance of two points P & Q from the focus of a parabola $y^2 = 4ax$ are 4 & 9, then the distance of the point of intersection of tangents at P & Q from the focus is -

(A) 8 (B) 6

(C) 5 (D) 13

Q.63 The range of 'k' for which the inequality $(k-2)\ x^2 + 4x + 2(k-3) < 0$ is true for all real 'x' is

(A) $k \in (-\infty, 1)$ (B) $k \in (-\infty, 2)$

(C) $k \in (-\infty, 1) \cup (4, \infty)$ (D) $k \in (1, 2)$

Q.64 Let the n^{th} terms of a series be given by $t_n = \frac{n^2 - n - 2}{n^2 + 3n}$, $n \geq 3$.

The product $t_3, t_4 \ldots t_{50}$ equals -

(A) $\frac{1}{5^2.7.13.53}$ (B) $\frac{1}{5.7^2.12.53}$

(C) $\frac{1}{5^2.7.12.51}$ (D) $\frac{1}{5.7^2.13.53}$

Q.65 Consider following expressions –

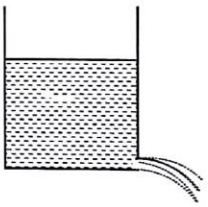
$$P = \prod_{\theta=1^\circ}^{100^\circ} \cos\theta;\ Q = \prod_{\phi=1}^{10^\circ} \sin\phi;\ R = \log_{\cos ec 0.8^\circ} \pi$$

Then number of non positive elements in the set $\{P, Q, R\}$ is -

(A) 0 (B) 1 (C) 2 (D) 3

PHYSICS

Q.66 When a hole is made in the side of a container holding water, water flows out and follows a parabolic trajectory. If a hole is made in the side of container and the container is dropped in free fall (just before the starts coming out), the water flow (Neglect effect of surface tension)



(A) diminishes

(B) stops altogether

(C) goes out in a straight line

(D) curves upward

Q.67 Kinetic energy of a particle moving in a straight line varies with time as $K = 4t^2$. The force acting on the particle.

(A) is constant

(B) is increasing

(C) is decreasing

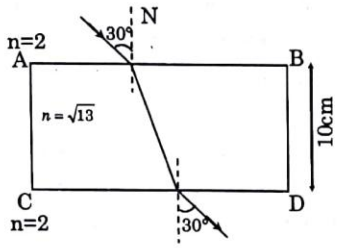
(D) first increases and then decreases

Q.68 In a process the pressure of a gas is inversely proportional to the square of the volume. If temperature of the gas increases, then work done by the gas -

(A) is positive (B) is negative

(C) is zero (D) may be positive

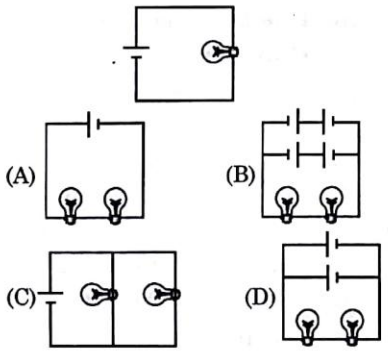
Q.69 Find the displacement of the ray after it imerges from *CD*



(A) 2.5 *cm* (B) 5 *cm*

(C) 1 *cm* (D) $\frac{\sqrt{13}}{3}$ *cm*

Q.70 In the diagrams, all light bulbs are identical and all *emf* sources are ideal and Identical. In which circuit (given in options) will each bulb glow with the same brightness as in the circuit shown ?



CHEMISTRY

Q.71 The angular momentum of an electron in a Bohr's orbit of He^+ is 3.1652×10^{-34} *kg-m²/sec*. What is the wave number in terms of Rydberg constant (R) of the spectral line emitted when an electron falls from this level to the first excited state. [Use $h = 6.626 \times 10^{-34}$ *J.s*]

(A) $3R$ (B) $\frac{5R}{9}$

(C) $\frac{3R}{4}$ (D) $\frac{8R}{9}$

Q.72 Some statements are given for the following equilibrium –

$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$; ΔH = +ve

S_1: On increase in temperature, equilibrium pressure of ammonia increases

S_2: On increase in volume of container at constant temperature, equilibrium pressure of ammonia increases.

S_3: On increase in mass of $NH_4HS(s)$ in the container at constant temperature, equilibrium pressure of ammonia increases.

(A) *T T T* (B) *F F F*

(C) *T T F* (D) *T F F*

Q.73 Which of the following is correct -

(A) H_3BO_3 can be considered to be a lewis acid

(B) The correct order of lewis acid strength order is $BF_3 > BCl_3 > BBr_3$

(C) One mole borax in aqueous solution will require one mole HCl for titration

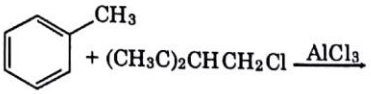
(D) B_2H_6 can be methylated completely to give $B_2(CH_3)_6$

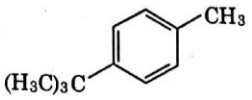
Q.74 How many isomers are possible of formula $C_6H_{14}O$ -

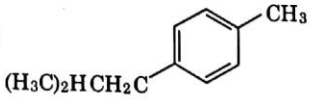
(A) 14 (B) 10

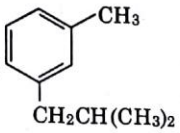
(C) 9 (D) 12

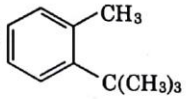
Q.75 The major product of the following reaction is –



(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.76 Sometimes urea is fed to ruminates to improve their health. It works by -

(A) Helping growth of gut microbes that break down cellulose

(B) Killing harmful microorganisms in their gut

(C) Increasing salt content in the gut

(D) Directly stimulating blood cell proliferation

Q.77 If you dip a sack full of paddy seeds in water overnight and then keep it out for a couple of days, it feels warm. What generates this heat ?

(A) lmbibation

(B) Exothermic reaction between water and seed coats

(C) Friction among seeds due to swelling

(D) Respiration

Q.78 The fluid part of blood flows in and out of capillaries in tissues to exchange nutrients and waste materials. Under which of the following conditions will fluid flow out from the capillaries into the surrounding tissue ?

(A) When arterial blood pressure exceeds blood osmotic pressure

(B) When arterial blood pressure is less than blood osmotic pressure

(C) When arterial blood pressure is equal to blood osmotic pressure

(D) Arterial blood pressure and blood osmotic pressure have nothing to do with the outflow of fluid from capilaries

Q.79 The interior of a cow-dung pile kept for a few days is quite warm. This is mostly because -

(A) Cellulose present in the dung is a good insulator

(B) Bacterial metabolism inside the dung release heat

(C) Undigested material releases heat due to oxidation by air

(D) Dung is dark and absorbs a lot of heat

Q.80 Single turn of citric acid cycle yields

(A) 2 $FADH_2$, 2$NADH_2$, 2GTP

(B) 1 $FADH_2$, 2$NADH_2$, 1GTP

(C) 1 $FADH_2$, 3$NADH_2$, 1GTP

(D) 1 $FADH_2$, 4$NADH_2$, 1GTP

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-5

Stream – SA

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 The least integer satisfying the equation, $\log_{\sqrt{3}}(|x|-|x-3|)=2$, is -

(A) 2 (B) 4

(C) 6 (D) none of these

Q.2 The number $\log_{12} 2\sqrt{3}$ is ..... .

(A) a prime number

(B) a composite number

(C) an irrational number

(D) None of these

Q.3 If sum of the coefficient in the expansion of $\left(-3x^2+\frac{2}{x}\right)^{2n+1}$ is 'a' then the value of 'b' for which roots of the equation $x^2+bx+6a=0$ are integral -

(A) {–7, –5, 5, 7} (B) {–7, –1, 1, 7}

(C) {–5, –1, 1, 5} (D) none of these

Q.4 If a complex number z and $z+\frac{1}{z}$ have same argument then -

(A) z must be purely real

(B) z must be purely imaginary

(C) z cannot be imaginary

(D) z must be real

Q.5 If $y = mx + C$ be a tangent to the parabola $(y-3)^2 + 8(x-2) = 0$ then the range of 'C' for all possible value(s) of m is

(A) $[-2, 2]$ (B) $(-\infty, -2] \cup [2, \infty)$

(C) $(-\infty, -1] \cup [7, \infty)$ (D) $(-\infty, -1] \cup [2, \infty)$

Q.6 The least natural number having no. of proper divisors as 18 is -

(A) 240 (B) 432

(C) 3072 (D) none of these

Q.7 A book contains 1000 pages. A page is chosen at random. The probability that the sum of the digits of the marked number on the page is equal to 9 is -

(A) 23/500 (B) 11/200

(C) 7/100 (D) none of these

Q.8 If 'x' is real, then the greatest value of the expression $\frac{x+2}{2x^2+3x+6}$ is -

(A) 1/13 (B) –1/13

(C) 3 (D) 1/3

Q.9 If the median of ΔABC through A is perpendicular to AB, then -

(A) $\tan A + \tan B = 0$

(B) $2\tan A + \tan B = 0$

(C) $\tan A + 2\tan B = 0$

(D) none of these

Q.10 If $A \equiv (0, 0)$, $B \equiv (3, 4)$ and $AP - BP = 5$ then locus of P is -

(A) a line (B) a line segment

(C) a pair of ray (D) none of these

Q.11 Number of real roots of the equation $\cos^7 x + \sin^4 x = 1$ in the interval $(-\pi, \pi)$ is less than -

(A) 6 (B) 4

(C) 5 (D) none of these

Q.12 The values of $16 \sin 144° \sin 108° \sin 72° \sin 36°$ is equal to -

(A) 4 (B) 3

(C) 5 (D) 6

Q.13 $\frac{\sin^3\theta - \cos^3\theta}{\sin\theta - \cos\theta} - \frac{\cos\theta}{\sqrt{1+\cot^2\theta}} - 2\tan\theta\cot\theta = -1$

if-

(A) $\theta \in \left(\frac{\pi}{2}, \pi\right)$ (B) $\theta \in \left(\frac{3\pi}{4}, \frac{5\pi}{4}\right)$

(C) $\theta \in \left(\pi, \frac{3\pi}{2}\right)$ (D) $\theta \in \left(\frac{3\pi}{2}, 2\pi\right)$

Q.14 If z is a complex number satisfying $|z - i\,\mathrm{Re}(z)| = |z - \mathrm{Im}(z)|$ then z lies on -

(A) $y = \pm x$ (B) $y = 2x$

(C) $y = x + 1$ (D) $y = -x + 1$

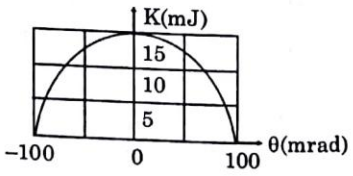
Q.15 The equation $z^2 + (\bar{z})^2 - 2|z|^2 + z + \bar{z} = 0$ represents a -

(A) straight line (B) circle

(C) hyperbola (D) parabola

PHYSICS

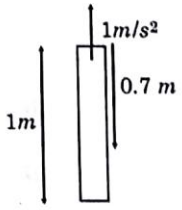
Q.16 Figure shows the kinetic energy K of a simple pendulum versus its angle θ from the vertical. The pendulum bob has mass 0.2 kg. The length of the pendulum is equal to ($g = 10\ m/s^2$) -



(A) 2.0 m (B) 1.8 m

(C) 1.5 m (D) 1.2 m

Q.17 A uniform rod of mass 10 kg and length 1 m is being taken vertically up with an acceleration of 1 m/s^2. Find tension in rod at 70 cm from upper end. (Take g = 10 m/s^2) –

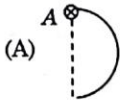


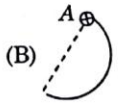
(A) 3 N (B) 30 N
(C) 110 N (D) 33 N

Q.18 A parachutist drops freely from an aeroplane for 10 s before the parachute opens out. Then he descends with a net retardation of 2.5 ms^{-2}. If he bails out of the plane at a height of 2495 m and g = 10 ms^{-2}, his velocity on reaching the ground will be -

(A) 2.5 ms^{-1} (B) 7.5 ms^{-1}
(C) 5 ms^{-1} (D) 10 ms^{-1}

Q.19 Which of the following figures best represents the stable equilibrium of a uniform semicircular rod in vertical plane. It is hinged at point A .

(A) 

(B) 

(C) 

(D) 

Q.20 Two identical long, solid cylinders are used to conduct heat from temp T_1 to temp T_2. Originally the cylinder are connected in series and the rate of heat transfer is H. If the cylinders are connected in parallel then the rate of heat transfer would be -

(A) $H/4$ (B) $2H$
(C) $4H$ (D) $8H$

Q.21 Two identical rooms in a perfectly insulated house are connected by an open doorway. The temperature in the two rooms are maintained at different values. The room which contains more air molecules is -

(A) the one with higher temperature
(B) the one with lower temperature
(C) the one with higher pressure
(D) neither since both have same volume

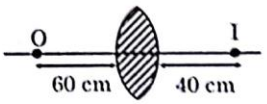
Q.22 A swimmer crosses the river along the line making an angle of 45° with the direction of flow. Velocity of the river water is 5 m/s. Swimmer takes 12 seconds to cross the river of width 60 m. The velocity of the swimmer with respect to water will be -

(A) 10 m/s (B) 5 m/s
(C) $5\sqrt{5}$ m/s (D) $5\sqrt{2}$ m/s

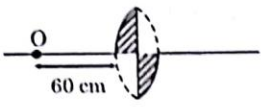
Q.23 Refractive index of a prism is $\sqrt{\frac{7}{3}}$ and the angle of prism is 60°. The minimum angle of incidence of a ray that will be transmitted through the prism is -

(A) 30° (B) 45°
(C) 15° (D) 50°

Q.24 A converging equiconvex lens forms real image of a particle as shown in case I. If now lens is cut as shown in case II then select the correct alternative/alternatives.



Case I



Case II

(A) Image in case II will be at 240 cm from lens

(B) Image is virtual

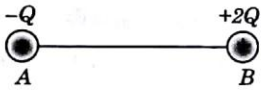
(C) Image in case II will be at the same location of case I.

(D) There will be two distinguished images

Q.25 A wire of resistance 'R' is cut into two equal parts. Now one part is stretched to double the length. Then the resistance of the stretched wire will be -

(A) R (B) $2R$ (C) $4R$ (D) $R/2$

Q.26 Charge $2Q$ and $-Q$ are placed as shown in figure. The point at which electric field intensity is zero will be –



(A) Somewhere between $-Q$ and $2Q$

(B) Somewhere on the left of $-Q$

(C) Somewhere on the right of $2Q$

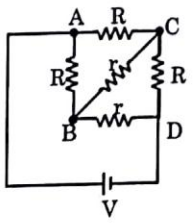
(D) Somewhere on the right bisector of line joining $-Q$ and $2Q$

Q.27 An engine pumps up 1000 kg of coal from a mine 100 m deep in 0.5 sec. The pump is running with diesel and efficiency of diesel engine is 25%. Then its power consumption will be ($g = 10\ m/sec^2$) –

(A) 200 kW (B) 8000 kW

(C) 1000 kW (D) 500 kW

Q.28 In the given circuit diagram, potential difference between A and C is $\frac{V}{4}$, then current in branch BC is –



(A) $\frac{V}{2R}$ (B) $\frac{V}{4r}$

(C) zero (D) $\frac{3V}{4r}$

Q.29 The radionuclide ^{238}U decays by emitting an alpha particle.

$^{238}U \longrightarrow {}^{234}Th + {}^{4}He$

The atomic masses of the three isotopes are –

^{238}U 238.05079 amu

^{238}U 234.04363 amu

^{4}He 4.00260 amu

What is the maximum kinetic energy of the emitted alpha particle. Express your answer in joule. ($1\ amu = 1.67 \times 10^{-27}\ kg$)

(A) $6.8 \times 10^{-14}\ J$ (B) $6.8 \times 10^{-13}\ J$

(C) $4.3 \times 10^{-14}\ J$ (D) $4.3 \times 10^{-13}\ J$

Q.30 The root mean square speed of molecules of gas in a container is 600 m/s. If half of gas leaks out at constant temperature, the rms speed of remaining molecule will be -

(A) 1200 m/s (B) $600\sqrt{2}\ m/s$

(C) 600 m/s (D) 300 m/s

CHEMISTRY

Q.31 How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3 ? The concentrated acid is 70% HNO_3.

(A) 90.0 g conc. HNO_3

(B) 70.0 g conc. HNO_3

(C) 54.0 g conc. HNO_3

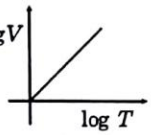
(D) 45.0 g conc. HNO_3

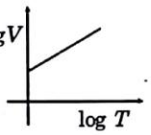
Q.32 Light of wavelength λ falls on a metal having work function hc/λ_0. Photoelectric effect will take place only if -

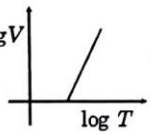
(A) $\lambda \geq \lambda_0$ (B) $\lambda \geq 2\lambda_0$

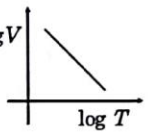
(C) $\lambda \leq \lambda_0$ (D) $\lambda \leq \lambda_0/2$

Q.33 Which of the following sketches is an isobar $\left(\frac{nR}{P} > 1\right)$ -

(A) 

(B) 

(C) 

(D) 

Q.34 Two flasks A and B of equal volume containing 1 mole and 2 mole of O_3 respectively are heated to the same temperature. When the reaction $2O_3 \rightleftharpoons 3O_2$ practically stops, then both the flasks shall have -

(A) the same ratio $[O_2] / [O_3]$

(B) the same ratio $[O_2]^{3/2} / [O_3]$

(C) Only O_2

(D) the same time to reach equilibrium

Q.35 The most stable oxidation state of thallium & bismuth are respectively -

(A) +3, +3 (B) +1, +5

(C) +1, +3 (D) +1, +1

Q.36 Number of 2 centre – 2 – electron bond in B_2H_6.

(A) 1 (B) 2

(C) 3 (D) 4

Q.37 In manufacture of sodium carbonate from Solvay (or ammonia soda) process the raw material used is -

(A) NaOH (B) Na_2SO_4

(C) NaCl (D) $NaHCO_3$

Q.38 What is the value of X in the given chemical formula of crystalline borax ?

$Na_2[B_4O_5(OH)_4] \cdot XH_2O$

(A) 5 (B) 6

(C) 7 (D) 8

Q.39 Only N_2, CO and CO_2 gases remain after 0.72 gm of carbon is treated with one litre of air at 27°C and 4.92 atm pressure Assume air composition O_2 = 20%, N_2 = 79% and CO_2 = 1% (by volume). The heat evolved (in kcal) under constant pressure is

Given : $C + O_2 \longrightarrow CO_2$, $\Delta H = -100$ kcal/mol

$C + \frac{1}{2} O_2 \longrightarrow CO$, $\Delta H = -25$ kcal/mol

(A) 1 kcal (B) 2 kcal

(C) 3 kcal (D) 4 kcal

Q.40 A solution contains 0.01 M Zn^{2+} and 0.01 M Cu^{2+} ions. It is saturated by passing H_2S gas in the solution. The S^{2-} ion concentration is 9.2×10^{-22} M. The solubility products of ZnS and CuS are 3.0×10^{-22} and 8.0×10^{-36} respectively. Which of the following is true ?

(A) ZnS will precipitate

(B) CuS will precipitate

(C) Both ZnS and CuS will precipitate

(D) Both Zn^{2+} and Cu^{2+} will remain in the solution

Q.41 Which of the following compound has only one type of hybridization of the carbon atoms ?

(A) $CH_2=CH-CH_2-CH_3$

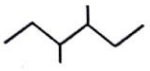
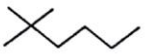
(B) $HC\equiv C-C\equiv CH$

(C) $CH_3-C\equiv C-CH_3$

(D) $CH_3-CH=CH-CH_3$

Q.42 Which compound is not the isomer of 3-Ethyl-2-methylpentane ?

(A)  (B) 

(C)  (D) 

Q.43 Quinine is the most important alkaloid obtained from cinchona bark. It's molecular formula is $C_{20}H_{24}N_2O_2$. It may contain -

(A) 5 double bond & 6 ring

(B) 6 double bond & 4 ring

(C) 6 double bond & 3 ring

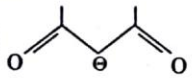
(D) 7 double bond & 5 ring

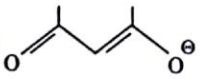
Q.44 Compound '*A*'(C_3H_6O), decolourizes Br_2 water. It liberates colourless, odourless gas on addition of sodium metal. On ozonolysis, it gives '*B*' and compound '*C*'($C_2H_4O_2$). Identify 'A'

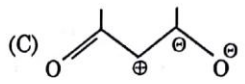
(A)  (B) $CH_2=CH-CH_2OH$

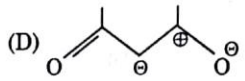
(C)  (D) CH_3-CH_2-CHO

Q.45 Which is the most stable resonating structure ?

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.46 Succus entericus is the name given to -

(A) Junction between ileum and large intestine

(B) Intestinal juice

(C) Swelling in the gut

(D) Appendix

Q.47 Rate and depth of respiration shall increase when -

(A) Oxygen concentration increases

(B) CO_2 concentration increases

(C) Bicarbonate concentration increases

(D) Bicarbonate concentration decreases

Q.48 One of the following Vessel is without valves -

(A) Artery (B) Vena cava

(C) Vein (D) Aorta

Q.49 Function of thymus is -

(A) Immunity

(B) Growth

(C) Formation of *RBC*s

(D)Emergency Hormone

Q.50 The cerebellum is concerned with the -

(A) Co-ordination of muscular movements

(B) Perception

(C) Memory

(D) Vision

Q.51 Part not belonging to uriniferous tubule is -
(A) Pelvis
(B) Henles loop
(C) Distal convoluted tubule
(D) *PCT*

Q.52 Intercostal muscles are found in -
(A) Fingers (B) Thoracic ribs
(C) Femur (D) Radius-ulna

Q.53 What is the common among mammals ?
(A) Carnivorous feeding habit
(B) Ventral nerve cord
(C) Moulting
(D) 7 cervical vertebrae

Q.54 What is the importance of respiration in plants ?
(A) It liberates energy (*ATP*)
(B) It provides oxygen to plants
(C) It liberates hydrogen
(D) all of these

Q.55 In animal cells the first stage of glucose breakdown is -
(A) Krebs cycle
(B) Glycolysis
(C) Oxidative phosphorylation
(D) *E.T.C.*

Q.56 Anaerobic respiration takes place in the -
(A) Mitochondria (B) Cytoplasm
(C) Lysosomes (D) *ER*

Q.57 Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants -
(A) Violet and Blue (B) Blue and Green
(C) Green and Red (D) Red and Violet

Q.58 Dark reaction of photosynthesis takes place in -
(A) Grana (B) Stroma
(C) Matrix (D) Cytoplasm

Q.59 The metal ion involved in the stomatal regulation or Stomata will open, if there is accumulation of the following element in the guard cells -
(A) Iron (B) Magnesium
(C) Zinc (D) Potassium

Q.60 Transiocation of sugar in flowering plants occurs in the form of -
(A) Maltose (B) Glucose
(C) Sucrose (D) Starch

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 Two circles each of radius 5 units touch each other at (1, 2). If the equation of their common tangent is $4x + 3y = 10$, then the centres of the two circles are -
(A) (3, 4), (–1, 10) (B) (5, 7), (–3, –3)
(C) (5, 5), (–3, –1) (D) (5, –3), (–3, 7)

Q.62 Tangent is drawn to the ellipse $x^2 + 2y^2 = 6$ at point (2, 1). If A and B are the feet of perpendiculars from the two focii on the tangent, then length AB is equal to -
(A) $\sqrt{3}$ (B) $\sqrt{2}$
(C) $\sqrt{6}$ (D) $\sqrt{12}$

Q.63 The value of the sum
$$\frac{1}{3^2+1}+\frac{1}{4^2+2}+\frac{1}{5^2+3}+\frac{1}{6^2+4}\ \ldots\ldots\infty$$
is equal to
(A) $\frac{13}{36}$ (B) $\frac{12}{36}$
(C) $\frac{15}{36}$ (D) $\frac{18}{36}$

Q.64 The co-ordinates of the circumcenter of the triangle formed by the lines –
$2x^2 + 3xy - 2y^2 - 6x + 8y - 8 = 0$ and
$x - y = 0$ is

(A) $\left(-\frac{1}{3},-\frac{1}{3}\right)$ (B) $\left(\frac{1}{3},-\frac{1}{3}\right)$

(C) (1, 1) (D) (–1, –1)

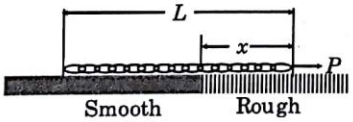
Q.65 If $x\sin\theta = y\sin\left(\theta+\frac{2\pi}{3}\right) = z\sin\left(\theta+\frac{4\pi}{3}\right)$ then

(A) $x+y+z=0$ (B) $xy+yz+zx=0$

(C) $xyz+x+y+z=1$ (D) none of these

PHYSICS

Q.66 A chain of length L is placed on a horizontal surface as shown in figure. At any instant x is the length of chain on rough surface and the remaining portion lies on smooth surface. Initially $x = 0$. A horzontal force P is applied to the chain (as shown in figure). In the duration x changes from $x = 0$ to $X = L$, for chain to move with constant speed.



(A) the magnitude of P should increase with time

(B) the magnitude of P should decrease

(C) the magnitude of P should increase first and then decrease with time

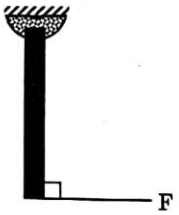
(D) the magnitude of P should decrease first and then increase with time

Q.67 A metal plate is exposed to light with wavelength λ. It is observed that electrons are ejected from the surface of the plate. When a retarding uniform electric field E is imposed, no electron can move away from the plate farther than a certain distance d. Then the threshold wavelength λ_0 for the material of plate is (e is the electronic charge, h is Planck's constant and c is the speed of light).

(A) $\lambda_0 = \left(\frac{1}{\lambda}-\frac{hc}{eEd}\right)^{-1}$ (B) $\lambda_0 = \left(\frac{1}{\lambda}-\frac{eEd}{hc}\right)^{-1}$

(C) $\lambda_0 = \lambda - \frac{hc}{eEd}$ (D) $\lambda_0 = \lambda - \frac{eEd}{hc}$

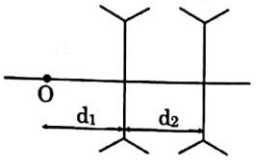
Q.68 A rod of mass m and length ℓ rests on a smooth horizontal ground and is hinged at one of its end. At the other end, a horizontal force F is applied whose magnitude is constant and the direction is always perpendicular to the rod. When the rod rotates by 90° angle, power supplied by the force at that instant is –



(A) $\sqrt{\frac{3F^3\pi\ell}{m}}$ (B) $\sqrt{\frac{3F^3\pi\ell}{2m}}$

(C) $\sqrt{\frac{3F^3\ell}{2m}}$ (D) $\sqrt{\frac{3F^3\ell}{m}}$

Q.69 Two diverging lenses are kept as shown in the figure. The final image formed will be –



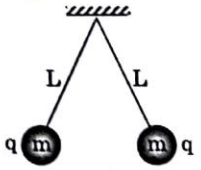
(A) virtual for any value of d_1 & d_2

(B) real for any value of d_1 and d_2

(C) virtual or real depends on d_1 & d_2 only

(D) virtual or real depends on d_1 & d_2 & also on the focal lengths of the lens

Q.70 Two small balls, each having equal length positive charge Q are suspended by two insulating strings of equal L from a hook fixed to a stand. If the whole setup is transferred to a satellite in orbit around the earth, the tension in equilibrium in each string is equal to –



(A) zero (B) $\frac{kQ}{L^2}$

(C) $\frac{kQ^2}{2L^2}$ (D) $\frac{kQ^2}{4L^2}$

CHEMISTRY

Q.71 Which of the following statements is false ?

(A) It is impossible to satisfy the octet rule for all atoms in XeF_2.

(B) $MgSO_4$ is soluble in water because hydration energy of $MgSO_4$ is higher in comparision to its lattice energy

(C) The bond in NO^+ should be stronger than the bond in NO^-

(D) For ozone molecule, one oxygen-oxygen bond is stronger than the other oxygen-oxygen bond

Q.72 PCl_5 is 10% dissociated at 1 atm. What is % dissociation at 4 atm.

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(A) 40 % (B) 2.5 %

(C) 5 % (D) 10 %

Q.73 The density of vapour of a substance (X) at 1atm pressure and 500 k is 0.8 kg/m^3. The vapour effuse through a small hole at a rate of 4/5 times slower than oxygen under the same condition. What is the compressibility factor (z) of the vapour ?

(A) 0.974 (B) 1.35

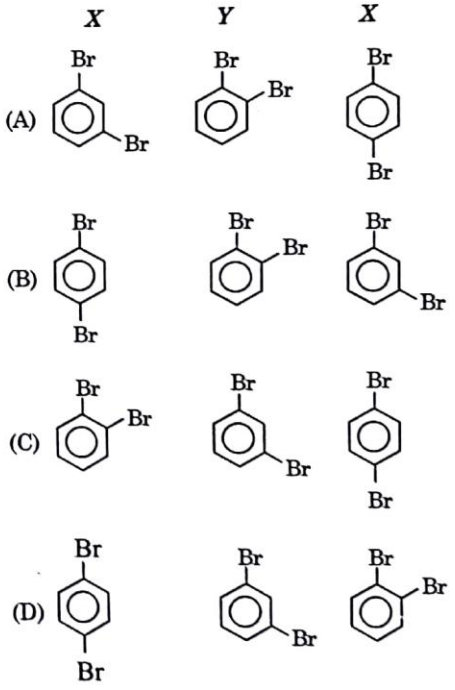
(C) 1.52 (D) 1.22

Q.74 Total number of position isomers of dimethyl cyclohexane -

(A) 2 (B) 3

(C) 4 (D) 5

Q.75 Three aromatic isomers X, Y, Z have molecular formula $C_6H_4Br_2$. On mononitration 'X' gives one, 'Y' gives two and 'Z' gives three isomeric products of molecular formula $C_6H_3Br_2NO_2$. Identify X, Y and Z



BIOLOGY

Q.76 A piece of bone such as femur of frog if kept in dilute HCl for about a week will -

(A) Assume black colour

(B) shrink in size

(C) turn flexible

(D) crack into pieces

Q.77 A health disorder that results from the deficiency of Thyroxine in adults and characterised by (i) a low metabolic rate, (ii) increase in body weight and (iii) tendency to retain water in tissues is -

(A) Simple goitre (B) Myxoedema

(C) Cretinism (D) Hypothyroidism

Q.78 If one parent has blood group *A* and the other parent has blood group *B*. The offspring have which blood group-

(A) *AB* (B) *O*

(C) *B* (D) *A, B, AB, O*

Q.79 The sequential energy change in photosynthesis is -

(A) Light → Electrical → Chemical

(B) Electrical → Chemical

(C) Chemical → Electrical

(D) Light → Chemical

Q.80 Dry wooden stakes, if driven into a small crack in a rock and then soaked, can develop enough pressure to split the rock. Such pressure is build up through the phenomenon of -

(A) Imbibition

(B) Deplasmolysis

(C) Turgor pressure

(D) Osmotic pressure

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-6

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 The number $5\sqrt{41}$ lies between -

(A) 29 and 30 (B) 30 and 31

(C) 31 and 32 (D) 32 and 33

Q.2 If $3x + 3y - 1$, $4x^2 + y - 5$, $4x + 2y$ are the sides of an equilateral triangle, its area is closest to the integer-

(A) 84 (B) 85

(C) 86 (D) 87

Q.3 Let a, b be two positive real numbers such that $a < b < \frac{1}{a}$ and let $x = \left(a + \frac{1}{a}\right) - \left(b + \frac{1}{b}\right)$. Then-

(A) x is always greater than zero

(B) x is always less than zero

(C) x = 0

(D) No such definite conclusion can be drawn about x

Q.4 Let T be the number of 4-digit integers, each ending in 3(in units place) and each divisible by 11. Then-

(A) $70 \le T \le 79$ (B) $80 \le T \le 89$

(C) $90 \le T \le 99$ (D) $T \ge 100$

Q.5 At what time (to the nearest second) immediately after 4 O' clock will angle between the hands of the clock be the same as that at 4 O' clock ?

(A) $4^h\ 42^m50^s$ (B) $4^h\ 43^m38^s$

(C) $4^h\ 43^m40^s$ (D) $5^h\ 5^m27^s$

Q.6 The sum of all the numbers which can be formed by using the digits 1, 3, 5, 7 all at a time and which have no digit repeated is –

(A) $16 \times 4!$ (B) $1111 \times 3!$

(C) $16 \times 1111 \times 3!$ (D) $16 \times 1111 \times 4!$

Q.7 The number of real values of a for which the cubic equation $x^3 - 3ax^2 + 3ax - a = 0$ has all real roots one of which is 'a' itself, is

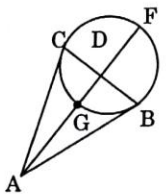
(A) 0 (B) 1 (C) 2 (D) 3

Q.8 The product of three consecutive natural numbers is 124850054994. What is their average?

(A) 4993 (B) 4994

(C) 4998 (D) 4997

Q.9 ΔABC is such that a circle touches AB at B which passes through Centroid 'G' of ΔABC & point C. If $AB = 6$, $BC = 4$, then AC is equal to -



(A) $2\sqrt{2}$ (B) $3\sqrt{2}$

(C) $2\sqrt{14}$ (D) $2\sqrt{13}$

Q.10 If $x^2 + y^2 + z^2 = 1$ then the value of $xy + yz + zx$ lies in the interval-

(A) $\left[\frac{1}{2}, 2\right]$ (B) $[-1, 2]$

(C) $\left[-\frac{1}{2}, 1\right]$ (D) None of these

Q.11 The three lines whose combined equation is $y^3 - 4x^2y = 0$ form a triangle which is-

(A) isosceles (B) equilateral

(C) right angled (D) None of these

Q.12 ABC is an equilateral triangle such that the vertices B and C lie on two parallel lines at a distance 6. If A lies between the parallel lines at a distance 4 from one of them then the length of a side of the equilateral triangle is-

(A) 8 (B) $\sqrt{\frac{88}{3}}$

(C) $\frac{4\sqrt{7}}{\sqrt{3}}$ (D) None of these

Q.13 A rocket of height h metres is fired vertically upwards. Its velocity at time t seconds is $(2t + 3)$ metres/second. If the angle of elevation of the top of the rocket from a point on the ground after 1 second of firing is $\pi/6$ and after 3 seconds it is $\pi/3$ then the distance of the point from the rocket is-

(A) $14\sqrt{3}$ metres

(B) $7\sqrt{3}$ metres

(C) $2\sqrt{3}$ metres

(D) cannot be found without the value of h

Q.14 John has x children by his first wife. Mary has $(x + 1)$ children by his first husband. They marry and have children of their own. The whole family has 24 children. Assuming that two children of the same parents do not fight. The maximum no. of fights are-

(A) 198 (B) 202

(C) 191 (D) 237

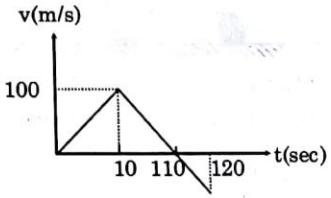
Q.15 If $y = 2x - 3$ is a tangent to the parabola $y^2 = 4a\left(x - \frac{1}{3}\right)$, then $\left|\frac{3a}{14}\right|$ is equal to-

(A) 2 (B) 1

(C) 3 (D) None of these

PHYSICS

Q.16 The graph shows the variation of velocity of a rocket with time. The maximum height attained by the rocket is –



(A) 11 km (B) 50 km

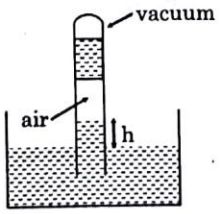
(C) 55 km (D) 60 km

Q.17 Two masses, 800 *kg* and 450 *kg* are at a distance 25 *m* apart. The magnitude of gravitational field intensity at a point 20 *m* distant from the 800 *kg* mass and 15 *m* distant from the 450 *kg* mass will be (in *N/kg*) – (*G* is universal gravitational constant) -

(A) $2G$ (B) $2\sqrt{2}G$

(C) $4G$ (D) zero

Q.18 The height of liquid in the tube below the air and above the liquid level in the container is *h*. The temperature of the air is now slightly increased. After the equilibrium state is achieved, the height *h* will (assume no change in the temperature of the liquid in the container)



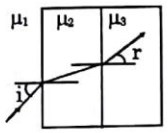
(A) remain same

(B) decrease

(C) increase

(D) decrease or increase, depending on the density of liquid above air

Q.19 In the figure shown $\frac{\sin i}{\sin r}$ is equal to –



(A) $\frac{\mu_2^2}{\mu_3\mu_1}$ (B) $\frac{\mu_3}{\mu_1}$

(C) $\frac{\mu_3\mu_1}{\mu_2^2}$ (D) none of these

Q.20 A point charge is moving in clockwise direction in a circle with constant speed. Consider the magnetic field produced by the charge at a point *P* (not centre of the circle) on the axis of the circle -

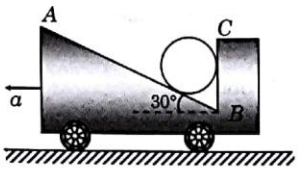
(A) It is constant in magnitude only

(B) It is constant in direction only

(C) It is constant in direction and magnitude both

(D) It is not constant in magnitude and direction both

Q.21 A cylinder rests in a supporting carriage as shown. The side *AB* of carriage makes an angle 30° with the horizontal and side *BC* is vertical. The carriage lies on a fixed horizontal surface and is being pulled towards left with an horizontal acceleration 'a'. The magnitude of normal reactions exerted by sides *AB* and *BC* of carriage on the cylinder be N_{AB} and N_{BC} respectively. Neglect friction everywhere. Then as the magnitude of acceleration 'a' of the carriage is increased, pick up the correct statement



(A) N_{AB} increases and N_{BC} decreases

(B) Both N_{AB} and N_{BC} increase

(C) N_{AB} remains constant and N_{BC} increases

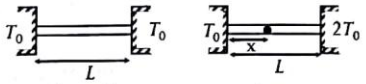
(D) N_{AB} increases and N_{BC} remains constant

Q.22 Heat required to vaporize $4g$ of water by boiling at $373K$ is 2160 calories. The specific heat of water in this condition is -

(A) 0.36 *cal/g-K* (B) 5.4 *cal/g-K*

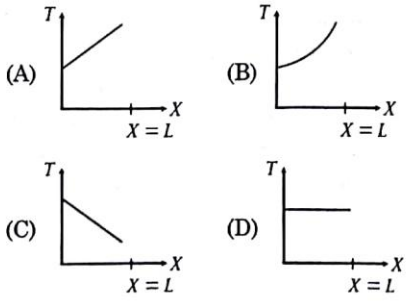
(C) zero (D) Infinity

Q.23 A uniform rod length L at room temperature T_0 just fits between two walls also at room temperature T_0, as shown in figure(i). Now the left wall is maintained at room temperature T_0 and right wall is maintained at temperature $2T_0$ as shown in figure (ii)-

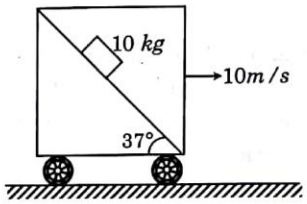


figure(i) figure(ii)

After the rod has achieved thermal steady state, the variation of tension in rod shown in figure(ii) as a function of distance x from left end is best represented by -



Q.24 A block of mass 10 kg is released on a fixed wedge inside a cart which is moved with constant velocity 10 m/s towards right. Take initial velocity of block with respect to cart zero. Then work done by normal reaction (with respect to ground) on block in two seconds will be ($g = 10\ m/s^2$)



(A) zero (B) 960 J

(C) 1200 J (D) none of these

Q.25 The phenomenon that sound wave fails to exhibit is-

(A) interference (B) diffraction

(C) vibrations (D) polarization

Q.26 Two identical nuclei A and B of the same radioactive element undergo β decay. A emits a β-particle and changes to A'. B emits a β-particle and then a γ-ray photon immediately afterwards and changes to B'

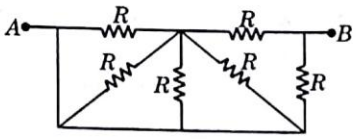
(A) A' and B' have the same atomic number and mass number

(B) A' and B' have the same atomic number but different mass numbers

(C) A' and B' have different atomic numbers but the same mass number

(D) A' and B' are isotopes

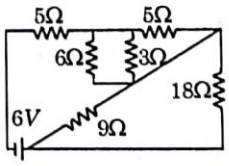
Q.27 The equivalent resistance between the points A and B is –



(A) $\frac{5R}{9}$ (B) $\frac{2R}{3}$

(C) R (D) none of these

Q.28 In the circuit shown, the cell of emf $6V$ is ideal. The resistor in which the power dissipated is greatest is –



(A) 5Ω (B) 3Ω (C) 9Ω (D) 18Ω

Q.29 A solid spherical black body of radius r and uniform mass distribution is in free space, It emits power 'P' and its rate of colling is R then -

(A) $RP \propto r^2$ (B) $RP \propto r$

(C) $RP \propto 1/r^2$ (D) $RP \propto \frac{1}{r}$

Q.30 A coin is released inside a lift at a height of $2m$ from the floor of the lift. The height of the lift is $10m$. The lift is moving with an acceleration of $9m/s^2$ downwards. The time after which the coin will strike with the lift is - ($g = 10\ m/s^2$) -

(A) $4s$ (B) $2s$ (C) $\frac{4}{\sqrt{21}}s$ (D) $\frac{2}{\sqrt{11}}s$

CHEMISTRY

Q.31 A person adds 1.71 gram of sugar ($C_{12}H_{22}O_{11}$) in order to sweeten his tea. The number of carbon atoms added are (mol. mass of sugar = 342) -

(A) 3.6×10^{22} (B) 7.2×10^{21}

(C) 0.05 (D) 6.6×10^{22}

Q.32 5.6 litre of oxygen at STP contains -

(A) 6.02×10^{23} atoms

(B) 3.01×10^{23} atoms

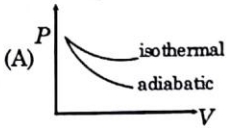
(C) 1.505×10^{23} atoms

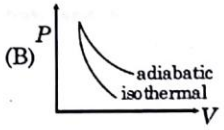
(D) 0.7525×10^{23} atoms

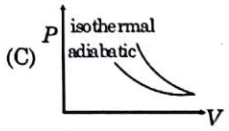
Q.33 For reaction $N_2O_4\ (g) \rightleftharpoons 2NO_2\ (g)$ at given temperature if $K_p = \frac{8}{5}$ atm for 30% degree of dissociation at equilibrium, then what will be new K_p for 50% dissociation of N_2O_4 at equilibrium at same temperature -

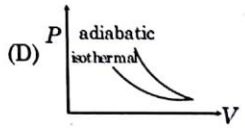
(A) $\frac{5}{8}$ (B) $\frac{8}{5}$ (C) $\frac{2}{5}$ (D) $\frac{12}{5}$

Q.34 The correct figure representing isothermal and adiabatic compression of an ideal gas from the same initial state is

(A) 

(B) 

(C) 

(D) 

Q.35 Which of the following p-orbitals overlapping would result in the strongest bond -

(A) 

(B) 

(C) 

(D) 

Q.36 Which of the following is not ionic in solid state -

(A) N_2O_5 (B) PCl_5

(C) ICl_3 (D) XeF_6

Q.37 The photon emitted due to electronic transition from 5th excited state to 2nd excited state in Li^{2+}, is used to excite He^+ already in first excited state. He^+ ion after absorbing the photon reaches in an orbit having total energy equal to -

(A) –3.4 *eV*. (B) –13.6 *eV*.

(C) –6.8 *eV*. (D) –27.2 *eV*.

Q.38 Which of the following statement is correct -

(A) Sodium metal can be produced by the electrolysis of an aqueous solution of *NaCl*

(B) *CsOH* has the maximum basicity and least solubility among all alkali metal hydroxides

(C) Gypsum when heated above 393 *K* forms Plaster of Paris

(D) The hydrated radii of alkaline earth metal ions decreases on moving down the group

Q.39 In which of the following process energy is liberated -

(A) $Cl(g) \rightarrow Cl^+(g) + e^-$

(B) $Na(g) \rightarrow Na^+(g) + e^-$

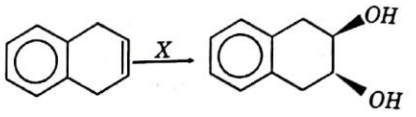
(C) $Be(g) + e^- \rightarrow Be^-(g)$

(D) $Li(g) + e^- \rightarrow Li^-(g)$

Q.40 A cylindrical container with a movable piston initially holds 1.5 mole of a gas at a pressure of 4 *atm* and a volume of 2.5 *L*. If the piston is moved to make volume 5*L*, while simultaneously withdrawing 0.75 moles of gas, what is the final pressure in atm ?

(A) 1 (B) 3

(C) 5 (D) 4

Q.41 

Reagent *X* will be -

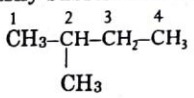
(A) 1% alkaline $KMnO_4$ (Bayer's reagent)

(B) $OsO_4/NaHSO_3$

(C) Peracid/H_3O^+

(D) (A) and (B) both

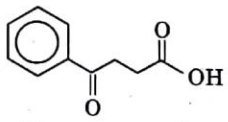
Q.42 In iso-pentane, the *H* atom that can be most easily substituted is on –

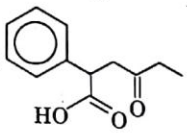


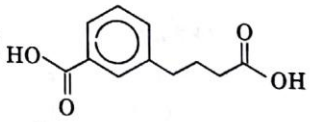
(A) *C*–1 (B) *C*–2

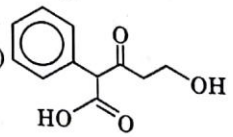
(C) *C*–3 (D) *C*–4

Q.43 Which of the following undergoes decarboxylation most readily on being heated ?

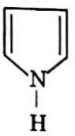
(A) 

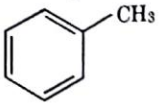
(B) 

(C) 

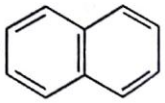
(D) 

Q.44 Which is a hetero aromatic compound ?

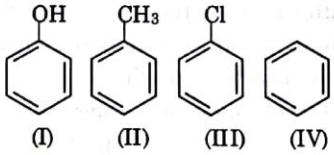
(A) 

(B) 

(C) 

(D) 

Q.45 Arrange the following compounds in the order of decreasing reactivity towards electrophilic substitution reaction –



(I) (II) (III) (IV)

(A) IV > III > II > I (B) I > II > IV > III

(C) I > II > III > IV (D) I > III > IV > II

BIOLOGY

Q.46 During prolong fating, the sequence of organic compounds used by body is -

(A) Carbohydrates, fats proteins

(B) Fats, carbohydrates, proteins

(C) Carbohydrates, proteins, lipids

(D) Proteins, lipids, carbohydrates

Q.47 In C_3 plants, CO_2 fixation occurs in -

(A) Stroma (B) Grana

(C) Outer membrane (D) inner membrane

Q.48 Anaerobic respiration is also Known as -

(A) Intramolecular

(B) Intermolecular respiration

(C) Extramolecular respiration

(D) Molecular respiration

Q.49 Diameter of the renal afferent vessel is -

(A) Same as that of efferent

(B) Smaller than that of efferent

(C) Larger than that of efferent

(D) There is no efferent vessel

Q.50 Which of the following mechanism would account for increased urine production ?

(A) Decreased amount of antidiretic hormone secretion

(B) Increased aldosterone production

(C) Increased blood pressure

(D) The proximal tubules reabsorbing more water

Q.51 Receptors for Neurotransmitter are located on the -

(A) Cell surface (B) Nucleus

(C) Endosome (D) Goldi apparatus

Q.52 Path-finding by ants is by means of -

(A) Visually observing landmarks

(B) Visually observing other ants

(C) Chemical signals between ants

(D) Using the earth's magnetic field

Q.53 Which cell organelle is abundantly found in while blood cells, secretory cells of liver, kidney, tadpole's tail and helps in degenerating action ?

(A) Mitochondria

(B) Golgi body

(C) Lysosome

(D) Endoplasmic reticulum

Q.54 Idioblast is -

(A) Plant cell different others

(B) Animal cell different from others

(C) Plant cell having cell inclusions

(D) Animals cell having cell inclusions

Q.55 Chromosomes are least condensed during

(A) Telophase (B) Interphase

(C) Metaphase (D) Anaphase

Q.56 A nitrogen-fixing microbe associated with Azolla in rice fields is -

(A) Spirulina (B) Anabaena

(C) Frankia (D) Tolypothrix

Q.57 Which of the following is more essential for the breaking of seed dormancy -

(A) Light (B) Heat

(C) Cold (D) Moisture

Q.58 Protein which plays a significant role in ageing is -

(A) Collagen (B) Elastin

(C) Actin (D) Myosin

Q.59 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as -

(A) Bicarbonate in blood plasma and *RBC*s

(B) Free CO_2 in blood plasma

(C) 70% carbamino-haemogolobin and 30% as bicarbonate

(D) Carbamino-haemoglobin in *RBC*s

Q.60 The Barr body is observed in -

(A) basophil of male

(B) neutrophil of female

(C) Basophill of female

(D) eosinophils

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 The number of distinct terms in the expansion of $\left(1+x+\frac{1}{x}+x^2+\frac{1}{x^2}\right)^{15}$ is/are

(A) 255 (B) 61

(C) 127 (D) None of these

Q.62 If the radius of the circle $(x-1)^2+(y-2)^2=1$ and $(x-7)^2+(y-10)^2=4$ are increasing uniformly w.r.t. time as 0.3 and 0.4 unit/sec, then they will touch each other at t equal to -

(A) 45 sec (B) 90 sec

(C) 11 sec (D) 135 sec

Q.63 The triangle formed by the tangent to the curve $f(x)=x^2+bx-b$ at the point (1, 1) and coordinate axes lies in the first quadrant. If its area is 2, then the value of $(-b)$ is.

(A) 1 (B) 2

(C) 3 (D) 4

Q.64 Let the straight line L : $\tan(\cot^{-1}2)\,x-y=4$ be rotated through an angle $\cot^{-1}3$ about the point M (0, –4) in anticlockwise sense. After rotation the line become tangent to the circle which lies in 4th quadrant and also touches coordinate axes. Find the sum of radii of all possible circles.

(A) 6 (B) 7

(C) 8 (D) none of these

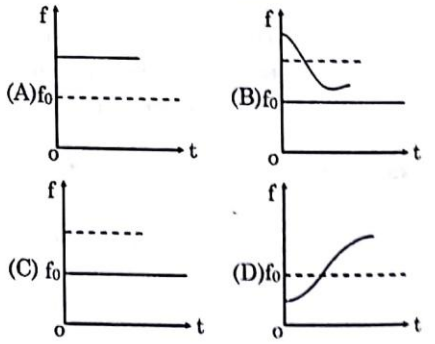
Q.65 Suppose a parabola $y=x^2-ax-1$ intersects the coordinate axes at three points A, B and C respectively. The circumcircle of ΔABC intersects the y-axis again at the point $D(0, t)$. Find the value of t.

(A) 1 (B) 2

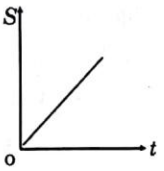
(C) 3 (D) None of these

PHYSICS

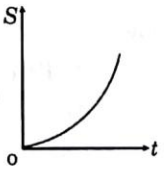
Q.66 Source and observer both start moving simultaneously from origin, one along x-axis and the other along y-axis with speed of source = 2 (speed of observer). The graph between the apparent frequency observe by observer (f) and time (t) would be: (f_0 = natural frequency of source)

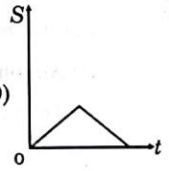


Q.67 One stone is dropped from a tower from rest and simultaneously another stone is projected vertically upward with some initial velocity. The graph of the distance (S) between the two stones varies with time (t) as: (before either stone hits the ground)

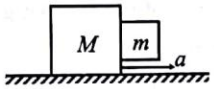
(A) 

(B) 

(C) 

(D) 

Q.68 In the figure, the coefficient of static friction between the two blocks is 0.5. Acceleration of the larger block (a) is 25 m/s^2. Then



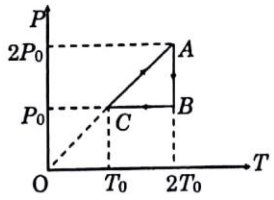
(A) smaller block slides down with respect to larger block

(B) smaller block remains stationary with respect to larger block

(C) smaller block slides up with respect to larger block

(D) limiting friction acts between the blocks

Q.69 Three moles of an ideal gas goes to a cyclic process shown in figure. The work done by the gas during the process is :



(A) 2.3 RT_0 (B) 0.58 RT_0

(C) 1.16 RT_0 (D) – 0.58 RT_0

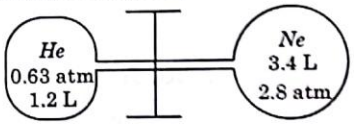
Q.70 A uniform ring of mass 'm' and radius 'R' is projected horizontally with velocity v_0 on a rough horizontal floor, so that it start off with a purely sliding motion and it acquires a purely rolling motion after moving a distance d. If the coefficient of friction between the ground and ring is μ, then work done by the friction in the process is–

(A) $-\mu mgd$ (B) $-\frac{1}{4}mv_0^2$

(C) $\mu\, mgd$ (D) $-\frac{1}{8}mv_0^2$

CHEMISTRY

Q.71 Two gas bulbs are connected by a thin tube calculate the partial pressure of He after the connective valve is opened at a constant temperature at 27°C



(A) 1 atm (B) .328 atm

(C) 1.64 atm (D) 0.166 atm

Q.72 Which of the following is/are correct ?

(A) When 1 mole of Zn is dissolved in excess HCl the work done is approximately equal to –2.46 kJ in open beaker at 300 K and 1 atm.

(B) When 1 mole of Zn is dissolved in excess HCl work done is equal to zero in closed beaker

(C) Both (A) and (B) are correct

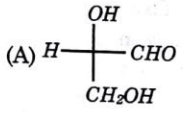
(D) Neither (A) and nor (B) are correct.

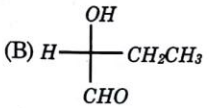
Q.73 Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture ?

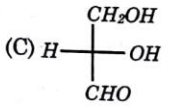
(A) $3.7 \times 10^{-3}\ M$ (B) $1.11 \times 10^{-3}\ M$

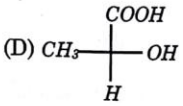
(C) $1.11 \times 10^{-4}\ M$ (D) $3.7 \times 10^{-4}\ M$

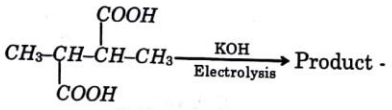
Q.74. Which of the following structures has the D-configuration ?

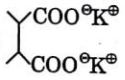
(A) 

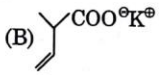
(B) 

(C) 

(D) 

Q.75 

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q76. Insulin is a polymer of -

(A) Fructose (B) Glucose

(C) Sucrose (D) Xylose

Q77. Which of the following specie's haploid cell has maximum chromosome counts ?

(A) *Ophioglossum* (B) Cat

(C) *Allium* (D) Dog

Q78. At which stage of cell cycle colchicines arrests the spindle ?

(A) Anaphase (B) Prophase

(C) Telophase (D) Interphase

Q79. Which one of the following acts as a barrier in a apoplasticpathway ?

(A) Epidermis (B) Plasmodesmata

(C) Casparian strips (D) Metaxylem

Q80. Which one of the following is not a part of symplast ?

(A) Cell wall

(B) Plasma membrane

(C) Plasmodesmata

(D) Cytoplasm

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-7

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 Numbers greater than 7000 & divisible by 5 which can be formed using digits 3,5,7,8 & 9, (no digit being repeated) is -

(A) 46 (B) 48

(C) 72 (D) 42

Q.2 The equation $\cos^8 x - b\cos^4 x + 1 = 0$ will have solution if 'b' belongs to

(A) $(-\infty, 2]$ (B) $[2, \infty)$

(C) $(-\infty, -2]$ (D) None of these

Q.3 Let $a_k = (k^2 + 1)\,k!$ & $b_k = a_1 + a_2 + a_3 \ldots + a_k$.

If $\frac{a_{100}}{b_{100}} = \frac{m}{n}$, then $n - m$ equals

(A) 100 (B) 99

(C) 98 (D) None of these

Q.4 If $t_n = n(n + 1)(n + 2)$ then $\sum_{n=1}^{\infty} \frac{1}{t_n}$ is equal to

(A) 1/2 (B) 1/4

(C) 1 (D) None of these

Q.5 If P_1Q_1 & P_2Q_2 or are two focal chords of $y^2 = 4ax$, then the chord P_1P_2 & Q_1Q_2 intersect on
(A) axis
(B) directrix
(C) tangent at vertex
(D) None of these

Q.6 If $(3 + x^{2008} + x^{2009})^{2010} = a_0 + a_1x + a_2x^2 + ... + a_nx^n$, then the value of
$a_0 - \frac{1}{2}a_1 - \frac{1}{2}a_2 + a_3 - \frac{1}{2}a_4 - \frac{1}{2}a_5 + a_6 - ....$
is-
(A) 3^{2010} (B) 1
(C) 2^{2010} (D) None of these

Q.7 Sum of the non-real roots of
$(x^2 + x - 2)(x^2 + x - 3) = 12$ is -
(A) 1 (B) –1
(C) –6 (D) 6

Q.8 The sum of the digits in a two-digit number is 6. If we add 18 to that number, we get a number consisting of the same digits written in the reverse order. Then the number, is -
(A) 42 (B) 23
(C) 32 (D) 24

Q.9 If $a679b$ is a five digit number that is divisible by 72 determine 'a' and 'b'.
(A) $a = 2, b = 3$ (B) $a = 3, b = 2$
(C) $a = 3, b = 1$ (D) None of these

Q.10 The number which is four more than the square of 625 has exactly two prime factors. Determine what they are ?
(A) 577 & 677 (B) 575 & 675
(C) 579 & 679 (D) None of these

Q.11 Let 'p' and 'q' be the roots of the equation, $x^2 - 2x + A = 0$, and let "r" and "s" be the roots of the equation $x^2 - 18x + B = 0$. If $p < q < r < s$ are in $A.P.$ the value of $(A + B)$ equals -
(A) 80 (B) 77
(C) 75 (D) 74

Q.12 The point of the curve $3x^2 - 4y^2 = 72$ which is nearest to the line $3x + 2y - 1 = 0$ is:
(A) (+6, 3) (B) (6, –3)
(C) (6, 6) (D) (6, 5)

Q.13 The equations $5x^2 + ax + 1 = 0$, $4x^2 + bx + 1 = 0$ have a common root, then the sum of the reciprocals of the other two roots is -
(A) $b - a$ (B) $2(b - a)$
(C) $3(b - a)$ (D) $9(b - a)$

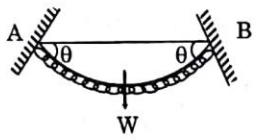
Q.14 Value of $\sum_{r=0}^{n} \frac{(-1)^r \, {}^{n+1}C_{r+1}}{{}^{r+2}C_{r+1}}$ equals -
(A) $\frac{n+2}{n+1}$ (B) $\frac{n+1}{n+2}$
(C) $\frac{n+1}{n+3}$ (D) $\frac{n+3}{n+1}$

Q.15 Let $P(\alpha_1, \beta_1)$, $Q(\alpha_2, \beta_2)$ and $R(\alpha_3, \beta_3)$ be the centroid, orthocentere and circumcentre of a scalene triangle. If P, Q, R lie on the curve $y^2 = x^3$, then $\frac{\alpha_1}{\beta_1} + \frac{\alpha_2}{\beta_2} + \frac{\alpha_3}{\beta_3}$ is equal to-
(A) 1 (B) 0
(C) 2 (D) 3/2

PHYSICS

Q.16 Two balls of equal masses are thrown upwards, along the same vertical direction at an interval of 2 seconds, with the same initial velocity of 40 m/s. Then these collide at a height of (take g = 10 m/s^2)
(A) 120 m (B) 75 m
(C) 200 m (D) 45 m

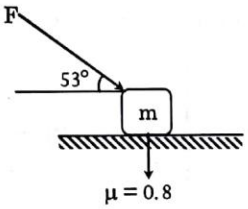
Q.17 A flexible chain of weight W hangs between two fixed points A and B at the same level. The inclination of the chain with the horizontal at the two points of support is θ. What is the tension of the chain at the endpoint –



(A) $\frac{W}{2}\text{cosec}\theta$ (B) $\frac{W}{2}\sec\theta$

(C) $W\cos\theta$ (D) $\frac{W}{3}\sin\theta$

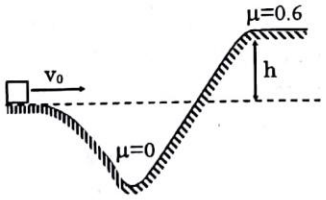
Q.18 A block of mass m rests on a rough horizontal surface, having friction coefficient $\mu = 0.8$. A force F is applied on the block at an angle 53° to the horizontal. What should be the minimum value of F, so that the block starts sliding ?



(A) 20 *mg* (B) 10 *mg*

(C) 2 *mg* (D) None of these

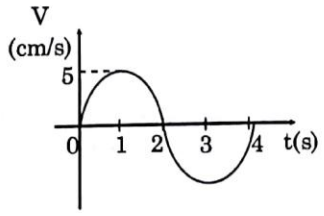
Q.19 In the figure a block slides along a track from one level to a higher level, by moving through an intermediate valley. The track is frictionless until the block reaches the higher level. There a frictional force stops the block in a distance d. The block's initial speed v_0 is 6 *m/s*, the height difference h is 1.1 m and the coefficient of kinetic friction μ is 0.6. The value of d is -



(A) 1.17 *m* (B) 1.71 *m*

(C) 7.11 *m* (D) 11.7 *m*

Q.20 A certain transverse sinusoidal wavelength 20 cm is moving in the positive x direction. The transverse velocity of the particle at $x = 0$ as function of time is shown. The amplitude of the motion is-



(A) $\frac{5}{\pi}$ cm (B) $\frac{\pi}{2}$ cm

(C) $\frac{10}{\pi}$ cm (D) 2π cm

Q.21 Which of the following is correct for the molecules of a gas in thermal equilibrium ?

(A) All have the same speed

(B) All have different speeds which remain constant

(C) They have a certain constant average speed

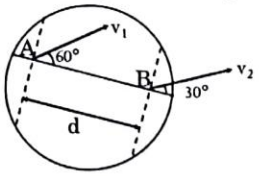
(D) They do not collide with one another

Q.22 A body is projected up along the rough inclined plane from the bottom with some velocity. It travels up the incline and then returns back. If the time of ascent is t_a and time of descent is t_d, then -

(A) $t_a = t_d$ (B) $t_a > t_d$

(C) $t_a < t_d$ (D) data insufficient

Q.23 Two points A & B on a disc have velocity v_1 & v_2 at some moment. Their directions make angles 60° and 30° respectively with the line of separation as shown in figure. The angular velocity of disc is -



(A) $\frac{\sqrt{3}v_1}{d}$ (B) $\frac{v_2}{\sqrt{3}d}$

(C) $\frac{v_2 - v_1}{d}$ (D) $\frac{v_2}{d}$

Q.24 A gas is contained in a metallic cylinder fitted with a piston. The gas is suddenly compressed by pushing piston downward and is maintained at this position. After this process, as time passes the pressure of the gas in the cylinder -

(A) increases

(B) decreases

(C) remains constant

(D) increases or decreases depending on the nature of the gas

Q.25 Two water pipes TP and Q having diameters 2×10^{-2} m and 4×10^{-2} m, respectively, are joined in series with the main supply line of water. The velocity of water flowing in pipe P is -

(A) 4 times that of Q

(B) 2 times that of Q

(C) 1/2 times that of Q

(D) 1/4 times that of Q

Q.26 A particle moves position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under the action of force $4\hat{i} + \hat{j} + 3\hat{k}$ N. The work done by this force will be -

(A) 100 J (B) 50 J

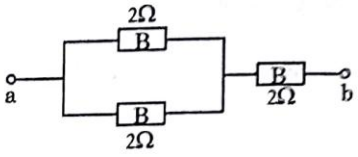
(C) 200 J (D) 75 J

Q.27 A ball of mass 'm', moving with uniform speed, collides elastically with another stationary ball. The incident ball will lose maximum kinetic energy when the mass of the stationary ball is -

(A) m (B) $2m$

(C) 4 m (D) infinity

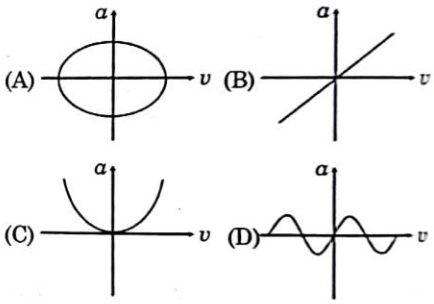
Q.28 Three identical bulbs each of resistance 2Ω are connected as shown. The maximum power that can be consumed by individual bulb is $32W$, then the maximum power consumed by the combination is -



(A) 48 W (B) 96 W

(C) 128 W (D) 160 W

Q.29 If the speed (v) of the bob in a simple pendulum is plotted against the tangential acceleration (a) the correct graph will be represented by -



Q.30 Sinusoidal waves 5.00 cm in amplitude are to be transmitted along a string having a linear mass density equal to 4.00×10^{-2} kg/m. If the source can deliver a average power of $90W$ and the string is

(A) 45 Hz (B) 50 Hz

(C) 30 Hz (D) 62 Hz

CHEMISTRY

Q.31 How many ml water should be added to 100 ml HCl solution (d = 1.5 g/ml) 80% by wt. to make it a solution of 40% by wt of density = 1 g/ml.

(A) 100 ml (B) 300 ml

(C) 200 ml (D) none of these

Q.32 In a hydrogen like sample two different types of photons A and B are produced by electronic transition Photon B has it's wavelength in infrared region if photon A has more energy than B, then the photon A may belong to the region -

(A) ultraviolet (B) visible

(C) infrared (D) all of these

Q.33 Which is wrong about P_4O_{10} molecule -

(A) each 'P' atom can be considered to be sp^3 hybridised

(B) there are six POP bonds in the molecule

(C) there are two types of P–O bond lengths

(D) POP angle is 180°

Q.34 If the dipole moment of AB molecule is given by 1.2 D and A-B the bond length is 1Å then % covalent character of the bond is -

(A) 25% (B) 75%

(C) 30% (D) 70%

Q.35 At STP, a container has 1 mole of Ar(argon), 3 moles of CO_2, 3 moles of O_2 and 4 moles of N_2. Without changing the total pressure, if 1 mole of O_2 is removed the partial pressure of O_2.

(A) decreases by 26% (B) decreases by 50%

(C) in unchanged (D) decrease by 45%

Q.36 Which is not correctly matched ?

1	Basic strength of oxides	$Cs_2O < Rb_2O < K_2O < Na_2O < Li_2O$
2	Stability of peroxides	$Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$
3	Stablility of bicarbonates	$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$
4	Melting point	NaF < NaCl < NaBr < NaI

(A) 1 and 4 (B) 1 and 3

(C) 1 and 2 (D) 2 and 3

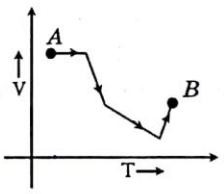
Q.37 The first four ionization potentials (eV) are given for two elements X and Y. Identify them.

X:	8.296	25.149	37.92	259.298
Y:	5.318	47.29	71.65	98.88

(A) B, Na (B) Na, Be

(C) Be, B (D) Na, Mg

Q.38 For the following V-T plot for a gas undergoing a process from state A to state B. Select the correct alternative(s).



(A) Pressure constantly increases

(B) Pressure first increases, then decreases

(C) Final pressure is less than initial pressure

(D) Pressure first decreases then increases

Q.39 What is the minimum mass of $CaCO_3(s)$, below which it decomposes completely, required to establish equilibrium in a 6.50 litre container for the reaction -

(A) 32.5 g (B) 24.6 g

(C) 40.9 g (D) 8.0 gm

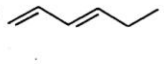
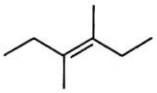
Q.40 In a homogeneous gaseous reaction,

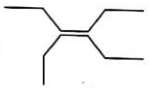
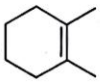
$A + 2B \rightleftharpoons 2C$, 2.0 mole of '$A$', 3.0 mole of '$B$' and 2.0 mole of '$C$' are placed in a 2.0 L flask and the equilibrium concentration of 'C' is 0.5 mole/L. The equilibrium constant (K_c) for the reaction is -

(A) 0.05 (B) 0.147

(C) 0.073 (D) 0.026

Q.41 Alkene on ozonolysis give only one product (x). x does not respond with Tollen's reagent and NaOI but give yellow precipitate with 2, 4-*DNP*, The structure of alkene can be -

(A)  (B) 

(C)  (D) 

Q.42 Among the following which is most polar -

(A) Diethylether (B) Ethyl iodide

(C) Acetaldehyde (D) Ethylamine

Q.43 Dinitrogen and dioxygen are main constituents of air but these do not react with each other to form oxides of nitrogen because -

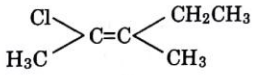
(A) the reaction is endothermic and requires very high temperature

(B) the reaction can be initiated only in presence of a catalyst.

(C) oxides of nitrogen are unstable

(D) N_2 and O_2 are unreactive

Q.44 The *IUPAC* name of the compound



is -

(A) trans-2-chloro-3-methyl-2-pentene

(B) cis-2-chloro-3-methyl-2-pentene

(C) trans-3-methyl-4-chloro-3-pentene

(D) cis-3-methyl-4-chloro-3-pentene

Q.45 Which of the following statement is incorrect ?

(A) A mixture of o-nitrophenol and *p*-nitrophenol can be separated by steam distillation

(B) Lassaigne's test can be used to detect nitrogen in hydrazine

(C) p-$NH_2C_6H_5SO_3H$ gives blood red colouration while performing Lassaigne's test for nitrogen

(D) Diazonium compounds lose N_2 on heating before they combine with fused sodium

BIOLOGY

Q.46 Plasmodium was reported for the first time by Laveran ..... forms in *RBC* of man and the species detected first time by him in world was -

(A) Amoeboid, vivas

(B) Signet ring stage, ovale

(C) Amoeboid, malariae

(D) Ameboid, falciparum

Q.47 A jelly like mesoglea is present in between the epidermis and gastrodermis in the body wall of Hydra that contains

(A) Interstitial cells (B) Epithelial cells

(C) Both above (D) None above

Q.48 The total number of ganglia in cockroach are

(A) Three pairs thoracic and three abdominal

(B) Three pairs thoracic and six pair abdominal

(C) Three pairs thoracic and eight pairs abdominal

(D) Two pairs thoracic and six pairs abdominal

Q.49 Maximum antibodies in the dermis are released by

(A) Killer – T- cells (B) Cytotoxic T - cells

(C) Null cells (D) Plasma cells

Q.50 The inactivated enzymes present in digestive tract like pepsinogen is an inactive form of pepsin. Such substances are called

(A) Zymogens (B) Catalyst

(C) Holoenzyme (D) Activators

Q.51 Which of the following statements correctly defines Bohr effect? Rise in
(A) P_{50} with a decrease in CO_2 conc
(B) P_{50} with decrease in pH
(C) P_{60} with decrease in pH
(D) P_{50} with a decrease in pH

Q.52 Myoglobin is present in red muscle fibres to
(A) Store oxygen to be utilized during muscle contraction
(B) Remove oxygen to help in anerobic respiration
(C) Compensate for lack of haemoglobin during anemia
(D) Remove pyruvic acid formed during respiration

Q.53 Release of rennin probably depends upon
(A) Glomerular filtration rate
(B) Sympathetic nerve activity
(C) Parasympathetic nerve activity
(D) (A) and (B)

Q.54 Which cranial nerve controls the heart muscles?
(A) Facial (B) Vagus
(C) Auditory (D) Trochlear

Q.55 A person passes much urine and drinks much water but his blood glucose level is normal. This condition may be the result of
(A) A reduction in insulin secretion from pancreas
(B) A reduction in vasopression secretion fro posterior pituitary
(C) A fall in the glucose concentration in urine
(D) An increase in secretion of glucagon

Q.56 Viroids have -
(A) *dsDNA* enclosed by protein coat
(B) *ssDNA* enclosed by protein coat
(C) *ssRNA* not enclosed by protein coat
(D) *dsRNA* enclosed by protein coat

Q.57 In gymnosperm, the multicellular female gametophyte is retained with in -
(A) Microsporangium
(B) Megasporangium
(C) Male gametophyte
(D) Archegonia

Q.58 Difference between rough and smooth endoplasmic reticulum is that -
(A) Rough *ER* has ribosomes
(B) Smooth *ER* has ribosomes
(C) Smooth *ER* takes part in protein synthesis
(D) Both has F_1-particles

Q.59 Organelles important in spindle formation during nuclear division is -
(A) Golgi body (B) Chloroplast
(C) Centriole (D) Mitochondrion

Q.60 Variety of amino acids are formed on the basis of -
(A) Position of hydroxyl group
(B) Position of carboxyl group
(C) Position of hydrogen
(D) Nature of *R* group

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 The sum of the series
$(1^2 + 1).\ \underline{1} + (2^2 + 1).\ \underline{2} + (3^2 + 1).\ \underline{3} + \ldots\ldots + (n^2 + 1).\ \underline{n}$ is -
(A) $(n + 1).\ \underline{(n + 2)}$ (B) $n.\underline{(n + 1)}$
(C) $(n + 1).\ \underline{(n + 1)}$ (D) none of these

Q.62 2 numbers x & y are chosen at random from the set of first 15 natural numbers (with replacement). The chance that $x^2 - y^2$ is divisible by 13, is -
(A) 2/21 (B) 3/35
(C) 31/225 (D) none of these

Q.63 If α is a root of the equation
$2x\ (2x + 1) = 1$, then the other root is -
(A) $-2\alpha\ (\alpha + 1)$ (B) $3\alpha^3 - 4\alpha$
(C) $3\alpha - 4\alpha^3$ (D) none of these

Q.64 If $\sqrt{1+\frac{1}{1^2}+\frac{1}{2^2}}+\sqrt{1+\frac{1}{2^2}+\frac{1}{3^2}}+\sqrt{1+\frac{1}{3^2}+\frac{1}{4^2}}+....+\sqrt{1+\frac{1}{(1999)^2}+\frac{1}{(2000)^2}}=x-\frac{1}{x}$, then find the value of x is -

(A) $x=2000, \frac{1}{2000}$

(B) $x=-2000, -\frac{1}{2000}$

(C) $x=2000, -\frac{1}{2000}$

(D) $x=20000, -\frac{1}{2000}$

Q.65 If $z=x+iy$ such that $\frac{|(2+i)z+(2-i)\bar{z}-3|}{2\sqrt{5}}=|z-1|$, then the locus of 'z' is

(A) parabola (B) ellipse

(C) hyperbola (D) pair of lines

PHYSICS

Q.66 A point charge + Q is placed at the centroid of an equilateral triangle. When a second charge + Q is placed at a vertex of the triangle, the magnitude of the electrostatic force on the central charge is 8N. The magnitude of the net force on the central charge when a third charge + Q is placed at another vertex of the triangle is –

(A) zero (B) 4 N

(C) $4\sqrt{2}$ N (D) 8 N

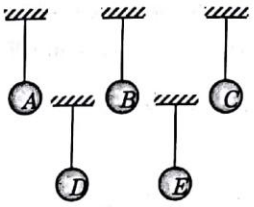
Q.67 Five styrofoam balls are suspended from insulating threads. Several experiments are performed on the balls and the following observations are made –

(i) Ball A repels C and attracts B.

(ii) Ball D attracts B and has no effect on E

(iii) A negatively charged rod attracts both A and E

An electrically neutral styrofoam ball gets attracted if placed nearby a charged body due to induced charge. What are the charges, if any on each ball ?



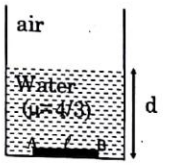
	A	B	C	D	E
(A)	+	–	+	0	+
(B)	+	–	+	+	0
(C)	+	–	+	0	0
(D)	–	+	–	0	0

Q.68 Two plane mirrors are inclined at 70°. A ray incident on one mirror at angle θ after reflection falls on the second mirror and is reflected from there parallel to the first mirror. θ is-

(A) 50° (B) 45°

(C) 30° (D) 55°

Q.69 AB is small object dipped in water at a depth of d. Its length is ℓ. It is seen from air at near normal incidence. The length of the image is –



(A) ℓ (B) $\mu\ell$

(C) ℓ/μ (D) none of these

Q.70 Part of the uranium decay series is shown

$_{92}U^{238} \longrightarrow {}_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} \longrightarrow {}_{92}U^{234} \longrightarrow {}_{90}Th^{230} \longrightarrow {}_{88}Ra^{226}$

How many pairs of isotopes are there in the above series

(A) 1 (B) 2

(C) 3 (D) 0

CHEMISTRY

Q.71 If the slope of 'Z' (compressibility factor) v/s 'P' curve is constant $\left(slope = \frac{\pi}{492.6} atm^{-1}\right)$ at a particular temperature (300 K) and very high pressure, then calculate diameter of the molecules. (Given : $N_A = 6.0 \times 10^{23}$, R = 0.0821 atm. lit mol^{-1} K^{-1})

(A) 7.5 $\AA$ (B) 5 $\AA$

(C) 2.5 $\AA$ (D) 1.25 $\AA$

Q.72 Calculate the pressure necessary to melt ice at $-10°C$ if molar volume of liquid water is 18.01 ml and molar volume of ice is 19.64 ml. Entropy change for process is 22.04 J/K -

(A) 500 atm (B) 1330 atm

(C) 1000 atm (D) 1350 atm

Q.73 Which of the following salts is the least soluble (in terms of moles/L) in water :

Salt	K_{sp}
$Ca(OH)_2$	7.9×10^{-6}
$CaCO_3$	4.8×10^{-9}
$CaSO_4$	2.4×10^{-5}
CaF_2	3.9×10^{-11}

(A) $Ca(OH)_2$ (B) $CaCO_3$

(C) $CaSO_4$ (D) CaF_2

Q.74 Which of the following is a secondary alcohol ?

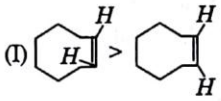
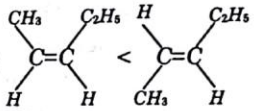
(A) Isobutyl alcohol

(B) Isoamyl alcohol

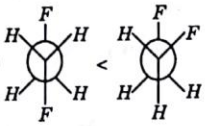
(C) Neopentyl alcohol

(D) Isopropyl alcohol

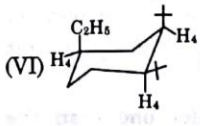
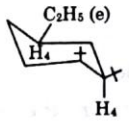
Q.75 What is incorrect order of stability ?

(I)  (II) 

(III) Boat from of 1,4-cyclohexan diol > Chair from of 1,4-cyclohexandiol

(IV) 

(V) Gauche form of succinic acid ($pH = 3$) > Anti form of succinic acid ($pH = 3$)

(VI)  

(A) I, II, V, VI (B) I, III, V, VI

(C) I, V, VI (D) I, VI

BIOLOGY

Q.76 In the lunch, you ate boiled green vegetables, a piece of cooked meat, one boiled egg and a sugar candy. Which one of these foods may have been digested first ?

(A) Boiled green vegetable

(B) The piece of cooked meat

(C) Boiled egg

(D) Sugar candy

Q.77 A swimmer crossing the British channel after 2 hrs of vigorous swimming experiences severe muscle armors and is forced to discontinue. Which of the following options given below could give rise to this problem -

(A) Muscle tear

(B) Sea winter diffusion into muscles

(C) Bite of pirranahas

(D) Lactic acid accumulation

Q.78 Root pressure on a tree is typically about 2-6 *atm*. This is sufficient to raise the water level upto a few feet. Tall trees get water at the top due to -

(A) Capillary rise and suction

(B) A pump operating in the growing tree

(C) Fed by rain water

(D) Water content in the atmosphere

Q.79 If you compare adults of two herbivore species of different sizes, but from the same geographical area, the amount of peaces produced per *kg* body weight would be -

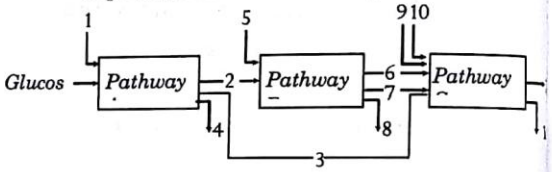
(A) More in the smaller one than the larger one

(B) More in the larger one than the smaller one

(C) Roughly the same amount in both

(D) Not possible to predict which be more

Q.80 The three boxes in this diagram represents the three major biosynthetic pathways in aerobic respiration Arrows represent net reactants or products -



Arrows number 4, 8 and 12 can all be -

(A) ATP (B) H_2O

(C) FAD^+ or $FADH_2$ (D) NADH

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-8

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

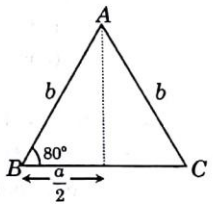
MATHEMATICS

Q.1 If $a + b + c = 0$ & $a^2 + b^2 + c^2 = 1$ then the value of $a^4 + b^4 + c^4$ is equal to -

(A) 2 (B) 4

(C) $\frac{1}{2}$ (D) 16

Q.2 In an isosceles triangle with base 'a' and vertical angle 20° and lateral side each b, $a^3 + b^3$ is equal to -



(A) $3ab^2$

(B) $3a^2b$

(C) $3ab\,(a + b)$

(D) $ab(a + b)$

Q.3 Let S denote the set of all complex numbers z satisfying the inequality $|z-5i| \le 3$. The complex numbers z in S having least positive argument is -

(A) $\frac{12-16i}{5}$ (B) $\frac{16+12i}{5}$

(C) $\frac{16-12i}{5}$ (D) $\frac{12+16i}{5}$

Q.4 The point of intersection of the tangents at the point P on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and its corresponding point Q on the auxiliary circle meet on the line :

(A) $x = a/e$ (B) $x = 0$

(C) $y = 0$ (D) None of these

Q.5 The bisector of the angle APB, where PA and PB are the tangents to the parabola $y^2 = 4ax$, is parallel to the bisector of the first quadrant. Then the point P lies on

(A) tangent at vertex of the parabola

(B) directrix of the parabola

(C) circle with centre at origin and radius a

(D) the line of latus rectum

Q.6 Number of numbers divisible by 25 that can be formed using only the digits 1, 2, 3, 4, 5 & 0 taken five at a time is :

(A) 2 (B) 32

(C) 42 (D) 52

Q.7 Box A has 3 white & 2 red balls, box B has 2 white & 4 red balls. If two balls are selected at random (without replacement) from A & 2 more are selected at random from B, the probability that all the four balls are white is :

(A) 10% (B) 2%

(C) 12% (D) 4%

Q.8 In a triangle ABC, $a : b : c = 4 : 5 : 6$. Then $3A + B =$

(A) $4C$ (B) 2π

(C) $\pi - C$ (D) π

Q.9 If $K = \sin\frac{\pi}{18}.\sin\frac{5\pi}{18}.\sin\frac{7\pi}{18}$ then the numerical value of K is -

(A) 1 (B) $\frac{1}{4}$

(C) $\frac{1}{8}$ (D) $\frac{1}{16}$

Q.10 If $A+B+C=\pi$, then $\cos A+\cos B-\cos C=$

(A) $-1+4\sin\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$

(B) $-1+4\cos\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

(C) $4\cos\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

(D) $-1+4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$

Q.11 Which of the following holds $\forall\, x \in (0, 1)$

(A) $\cos x < \cos x^2$ (B) $\sin x < \sin x^2$

(C) $\cos\frac{1}{x} > \cos\frac{1}{x^2}$ (D) $\sin\frac{1}{x} > \sin\frac{1}{x^2}$

Q.12 If A & B belongs to an interval in which graph of function $f(x) = \cot x$ is continuous, then the inequality $\cot A > \cot B$ implies.

(A) $A > B$

(B) $A = B$

(C) $A < B$

(D) Depends upon exact values of A & B

Q.13 z_1 & z_2 are two distinct points in an Argand plane. If $a|z_1| = b|z_2|$, then the point $\frac{az_1}{bz_2}+\frac{bz_2}{az_1}$ is a point on the $(a, b \in R)$:

(A) line segment [–2, 2] of the real axis

(B) line segment [–2, 2] of the imaginary axis

(C) unit circle $|z| = 1$

(D) the line with $\arg z = \tan^{-1}2$

Q.14 If 'z' is complex number then the locus of 'z' satisfying the condition $|2z-1| = |z-1|$ is

(A) A perpendicular bisector of line segment joining $\frac{1}{2}$ and 1

(B) circle

(C) parabola

(D) none of the above curves

Q.15 The locus of z satisfying the condition $|z-i| = |iz - i\bar{z} + 2|$ lies on

(A) parabola

(B) coincident lines

(C) hyperbola

(D) real and distinct pair of straight lines

PHYSICS

Q.16 A boat crosses a river of width 1 *km* in shortest path in 15 minutes. If the speed of boat in still water is 5 *km/hr*, then what is the speed of the river ?

(A) 1 *km/hr* (B) 3 *km/hr*

(C) 2 *km/hr* (D) 5 *km/hr*

Q.17 Two small balls having equal positive charge Q (Coulomb) on each are suspended by two insulating strings of equal length 'L' metre, from a hook fixed to a stand. The whole set up is taken in a satellite in to space where there is no gravity (state of weight lessness), Then the angle (θ) between the two strings is -

(A) 0° (B) 90°

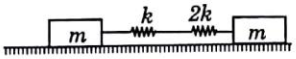
(C) 180° (D) $0° < \theta < 180°$

Q.18 Forty identical electric bulbs are connected in series across a 220 V supply. After one bulb is fused the remaining 39 are connected again in series across the same supply. The percentage with which the illumination of the bulbs will change will be –

(A) 10.25% (B) 7%

(C) 5% (D) 2.5%

Q.19 A system is shown in the figure. The time period for small oscillations of the two blocks will be -



(A) $2\pi\sqrt{\frac{3m}{k}}$ (B) $2\pi\sqrt{\frac{3m}{4k}}$

(C) $2\pi\sqrt{\frac{3m}{8k}}$ (D) $2\pi\sqrt{\frac{3m}{2k}}$

Q.20 A body is heated to temperature 40 degree and kept in a chamber maintained at 20°. If temperature decreases to 36° in 2 minutes. Time after it will further decrease by 4 degree is -

(A) 2 min (B) 2 min 33 sec

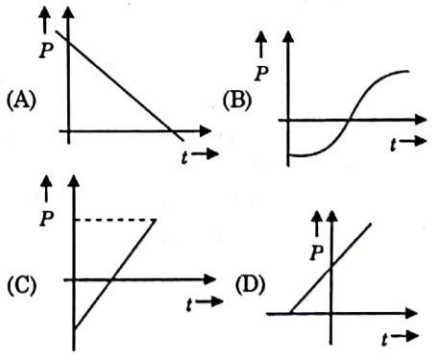
(C) 2 min 55 sec (D) 3 min

Q.21 Velocity of sound in He at certain temperature is 'v_0'. Velocity of sound in N_2 at that temperature will be -

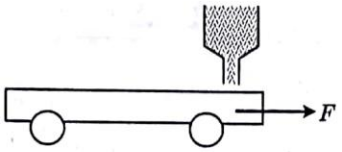
(A) $\frac{\sqrt{3}}{5} v_0$ (B) $\frac{\sqrt{3}}{7} v_0$

(C) $\frac{1}{\sqrt{7}} v_0$ (D) $\sqrt{\frac{3}{7}} v_0$

Q.22 A particle is projected with speed u in air at an angle θ with the horizontal. The graph showing the variation of instantaneous power due to gravity p with time t will be -



Q.23 A flat cart of mass m_0 starts moving to the right due to a constant horizontal force F at $t = 0$. Sands spills on the cart from a stationary hopper as shown in figure. The velocity of loading is constant and is equal to μ *kg/s*



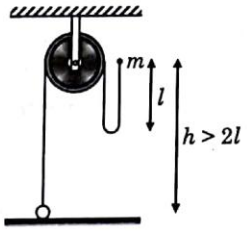
(A) Initial acceleration of cart is equal to $\frac{F}{m_0}$

(B) Acceleration at time t is $\frac{F}{(m_0+\mu t)}$

(C) Initial acceleration is less than $\frac{F}{m_0}$

(D) Both (A) and (B)

Q.24 In the figure shown, the heavy ball of mass $2m$ rests on the horizontal surface and the lighter ball of mass m is dropped from a height $h > 2l$. At the instant the string gets taut, the upward the velocity of the heavy ball will be -



(A) $\frac{2}{3}\sqrt{gl}$ (B) $\frac{4}{3}\sqrt{gl}$

(C) $\frac{1}{3}\sqrt{gl}$ (D) None

Q.25 A smooth sphere of mass m is moving on a horizontal plane with a velocity $(3\hat{i}+\hat{j})$. It collides with a vertical wall which is parallel to the vector $\hat{j}$. If $e = \frac{1}{2}$ then impulse $(\vec{J})$ that acts on the sphere is –

(A) $-\frac{9}{2}m\hat{i}$ (B) $\left(-\frac{3}{2}\hat{i}+\hat{j}\right)$

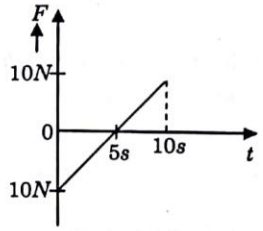
(C) $\frac{3}{2}m\hat{j}$ (D) $\left(\frac{3}{2}m\hat{j}+\frac{1}{2}m\hat{i}\right)$

Q.26 Power supplied to a particle of mass 2 *kg* varies with time as $P = \frac{3t^2}{2}$ watt. Here t is in seconds. If velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at time $t = 2$ will be -

(A) 1 *m/s* (B) 4 *m/s*

(C) 2 *m/s* (D) $2\sqrt{2}$ *m/s*

Q.27 A particle of mass $m = 1$ *kg*, starts moving on a straight line, with an initial velocity of 25 *m/sec* from the origin. According to the given force F versus time t curve -



(A) Momentum at $t = 5$ sec is zero

(B) Momentum is minimum at $t = 5$ sec

(C) Momentum cannot be obtained

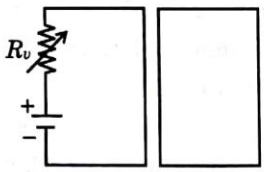
(D) both (A) and (B)

Q.28 Two identical, small, conducting spheres are separated by a distance of $1m$. The spheres originally have equal but opposite charges, and the force between them is F_0. Half of the charge on one sphere is then moved to the other sphere. The force between the spheres is now -

(A) $F_0/4$ (B) $F_0/2$

(C) $3F_0/4$ (D) $3F_0$

Q.29 Two loops lie in the plane of the paper, as shown. The resistance R_v in the left-hand circuit of figure below is being increased at a steady rate. What is the direction of the induced current in the right-hand circuit -



(A) into the page
(B) anticlockwise
(C) zero (there is no current in the right-hand circuit)
(D) clockwise

Q.30 A satellite in force free space sweeps stationary interplanetary dust a rate $\frac{dM}{dt} = \alpha v$, where M is the mass, v is the velocity of the satellite and α is a constant. The acceleration of the satellite is -

(A) $\frac{-2\alpha v}{M}$ (B) $\frac{-\alpha v^2}{M}$

(C) $\frac{\alpha v^2}{M}$ (D) $-\alpha v^2$

CHEMISTRY

Q.31 $K_c = 9$ for the reaction, $A + B \rightleftharpoons C + D$, If A and B are taken in equal amount, then amount of C in equilibrium is :

(A) 1 (B) 0.25
(C) 0.75 (D) None of these

Q.32 The value of K_p for the reaction,

$2H_2O(g) + 2C\ell_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$

is 0.03 atm at 427°C, when the partial pressure are expressed in atmosphere then the value of Kc for the same reaction is :

(A) 5.23×10^{-4} (B) 7.34×10^{-4}
(C) 3.2×10^{-3} (D) 5.43×10^{-5}

Q.33 In a certain electronic transition in the hydrogen atoms from an initial state (A) to a final state (B), the difference in the orbital radius ($r_1 - r_2$) is 24 times the first Bohr radius. Identify the transition.

(A) $5 \rightarrow 1$ (B) $25 \rightarrow 1$
(C) $8 \rightarrow 3$ (D) $6 \rightarrow 5$

Q.34 Consider the ground state of Cr atom ($Z = 24$). The numbers of electrons with the azimuthal quantum numbers, $\ell = 1$ and 2 are, respectively :

(A) 16 and 5 (B) 12 and 5
(C) 16 and 5 (D) 12 and 4

Q.35 Temperature at which r.m.s. speed of O_2 is equal to that of neon at 300 K is -

(A) 280 K (B) 480 K
(C) 680 K (D) 180 K

Q.36 A mixture of hydrogen and oxygen at one bar pressure contains 20% by weight of hydrogen. Partial pressure of hydrogen will be -

(A) 0.2 bar (B) 0.4 bar
(C) 0.6 bar (D) 0.8 bar

Q.37 The molarity of the solution containing 2.8%(mass/volume) solution of KOH is : (Given atomic mass of K = 39) is -

(A) 0.1 M (B) 0.5 M
(C) 0.2 M (D) 1 M

Q.38 12 g of alkaline earth metal gives 14.8 g of its nitride. Atomic weight of metal is -

(A) 12 (B) 20
(C) 40 (D) 14.8

Q.39 Which of the following is in order of increasing covalent character ?

(A) $CCl_4 < BeCl_2 < BCl_3 < LiCl$

(B) $LiCl < CCl_4 < BeCl_2 < BCl_3$

(C) $LiCl < BeCl_2 < BCl_3 < CCl_4$

(D) $LiCl < BeCl_2 < CCl_4 < BCl_3$

Q.40 The first ionisation enthalpies of Na, Mg, Al and Si are in the order :

(A) Na < Mg > Al < Si

(B) Na > Mg > Al > Si

(C) Na < Mg < Al < Si

(D) Na > Mg > Al < Si

Q.41 Which of the following are isomers.

(A) Methanol, Ethanol, Propanol

(B) Butane, Butene, Butyne

(C) Pentane, Isopentane, Neopentane

(D) Benzene, Hexene, Hexyne

Q.42 For an electrophilic substitution reaction, the presence of a halogen atom in the benzene ring.....

(A) deactivates the ring by inductive effect

(B) deactivates the ring by resonance

(C) increases the charge density at meta position by resonance

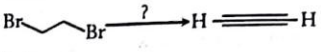
(D) directs the incoming electrophile to meta position by increasing the charge density relative to ortho and para positions

Q.43 The prussian blue colour obtained during the test of nitrogen by Lassaigne's test is due to the formation of :

(A) $Fe_4[Fe(CN)_6]_3$ (B) $Na_4[Fe(CN)_6]$

(C) $K_4[Fe(CN)_6]$ (D) $Na_4[Fe(CN)_5NOS]$

Q.44 The reagents(s) for the following conversion,



is/are :

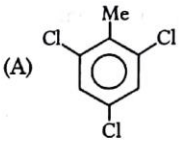
(A) alcoholic KOH

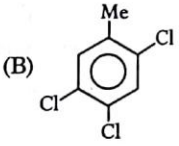
(B) alcoholic KOH followed by $NaNH_2$

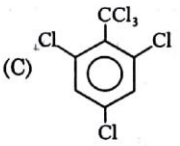
(C) aqueous KOH followed by $NaNH_2$

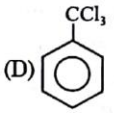
(D) Zn/CH_3OH

Q.45 By passing excess of $Cl_2(g)$ in boiling toluene which one of the following compound is exclusively formed ?

(A) 

(B) 

(C) 

(D) 

BIOLOGY

Q.46 Transduction is conducted with the help of

(A) Bacteria

(B) Bacteriophase

(C) Virulent strain bacteria

(D) Viroid

Q.47 Alzeimer's is a disease concerned with

(A) Circulatory system

(B) Excretory system

(C) Nervous system

(D) Respiratory system

Q.48 How many autosomes does a normal human inherit from mother ?

(A) 23 (B) 1 (C) 44 (D) 22

Q.49 The following structure is not found in animal cells
(A) ER (B) Centriole
(C) Lysosome (D) Sphaerosome

Q.50 Which organelle is connected with synthesis of glycoprotein & glycolipids
(A) ER (B) Golgibody
(C) Ribosome (D) Mithochondria

Q.51 If parents are heterozygous & normal for albinism. What will be the chance of appearance of albinic of spring of this couple.
(A) 25% (B) 50%
(C) 75% (D) 100%

Q.52 Oxidative decarboxylation of pyruvic acid takes place in
(A) Cytoplasm
(B) Matrix of Mitochondria
(C) Innermembrane of Mitochondria
(D) Outer surface of Mitochondria

Q.53 Elblow joint is an example of
(A) Pivot joint
(B) Hinge joint
(C) Gliding joint
(D) Ball and socket joint

Q.54 Protoplasm is made up of -
(A) Cytoplasm & nucleus
(B) Cytoplasm & nucleolus
(C) E.R. and Golgi body
(D) Mitochondria & plastids

Q.55 Which of the following part of nephron is least permeable to water
(A) Ascending limb of the loop of Henle
(B) Descending limb of the loop of Henle
(C) Proximal convoluted tubule
(D) Distal convoluted tubule

Q.56 Haversian system is a diagnostic feature of
(A) Avian bones
(B) All animals
(C) Mammalian bones only
(D) Reptilian bones

Q.57 Clitellum in earthworm includes segments.
(A) 19, 20, 21
(B) 14, 15, 16
(C) Last 3 segments
(D) first three segments

Q.58 During one circuit of blood from lungs to the tissue and back through the circulatory system the percentage of haemoglobin giving the oxygen is -
(A) 50% (B) 25%
(C) 75% (D) 100%

Q.59 Myofibrils are made up
(A) Myosin and actin
(B) Myosin and tropnin
(C) Actin and tropomyosin
(D) All the above components

Q.60 Removal of thymus gland in the early life of an experiment mammal will cause -
(A) Lack of lymphocytes
(B) Lack of antibodies
(C) Lack of lymph nodes and lymph vessels
(D) All of the above

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 A rhombus is inscribed in the region common to the two circles $x^2 + y^2 - 4x - 12 = 0$ and $x^2 + y^2 + 4x - 12 = 0$ with two of its vertex on the line joining the centres of the circle. The area of the rhombus is

(A) $8\sqrt{3}$ *sq.*unit (B) $4\sqrt{3}$ *sq.*unit

(C) $16\sqrt{3}$ *sq.*unit (D) None of these

Q.62 The number of points $P(x, y)$ lying inside or on the circle $x^2 + y^2 = 9$ and satisfying the equation $\tan^4 x + \cot^4 x + 2 = 4 \sin^2 y$, is

(A) 2 (B) 4

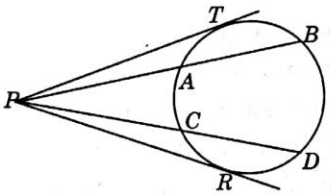
(C) 8 (D) infinite

Q.63 Number of 4 digit positive integer if the product of their digits is divisible by 3 is:

(A) 2700 (B) 6628

(C) 7704 (D) 5464

Q.64 In the given figure, if $PT = 10$, $PC = 5$ and $PB = 25$ then the value of $\frac{PD}{PA} + PR$ is



(A) 5 (B) 10

(C) 15 (D) 20

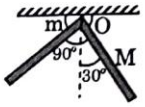
Q65 If $(2 + a\sqrt{3})^{50} + (2 + b\sqrt{3})^{50} = 5 + 4\sqrt{2}$, then number of pairs (a, b) for which the equation is true (a, b are rational numbers)

(A) 1 (B) 2

(C) 0 (D) None

PHYSICS

Q.66 Two uniform rods of equal length but different masses are rigidly joined to form an L-shaped body, which is then pivoted about O as shown in figure. If in equilibrium the body is in the shown configuration, ratio M/m will be :



(A) 2 (B) 3

(C) $\sqrt{2}$ (D) $\sqrt{3}$

Q.67 A ray of light falls on a plane mirror. When the mirror is turned, about an axis which is at right angle to the plane of the mirror through 20° the angle between the incident ray and new reflected ray is 45°. The angle between the incident ray and original reflected ray was therefore :

(A) 65° (B) 25° or 65°

(C) 25° (D) 45°

Q.68 In the figure a conductor of non-uniform cross-section is shown. A steady current I flows in it.

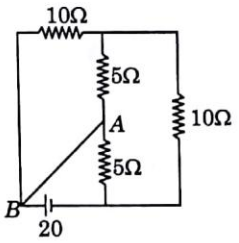
(A) The electric field at A is more than at B

(B) The electric field at B is more than at A

(C) The thermal power generated at A is less than at B in a element of small same width

(D) The thermal power generated at B is more than at A in an element of small same width

Q.69 In the circuit shown in figure find the current in branch AB of the circuit :



(A) 5 A (B) 0.5 A

(C) $\frac{11}{3}A$ (D) None of these

Q.70 A Toy cart attached to the end of an unstretched string of length a, when revolved moves on a smooth horizontal table in a circle of radius $2a$ with a time period T. Now the toy cart is speeded up until it moves in a circle of radius $3a$ with a period T'. If Hook's law holds then (Assume no friction)

(A) $T' = \sqrt{\frac{3}{2}}\,T$ (B) $T' = \left(\frac{\sqrt{3}}{2}\right)T$

(C) $T' = \left(\frac{3}{2}\right)T$ (D) $T' = T$

CHEMISTRY

Q.71 Calculate the entropy change when 3.6 g of liquid water is completely converted into vapour at 100°C. The molar heat of vaporization is 40.85 kJ mol^{-1}

(A) 6.08 JK^{-1} (B) 109.5 JK^{-1}

(C) 21.89 JK^{-1} (D) –21.89 JK^{-1}

Q.72 Determine enthalpy of formation for $H_2O_2(\ell)$, using the listed enthalpies of reactions :

$N_2H_4(\ell) + 2H_2O_2(\ell) \longrightarrow N_2(g) + 4H_2O(\ell)$; $\Delta_r H°_1 = -818$ kJ/mol

$N_2H_4(\ell) + O_2(g) \longrightarrow N_2(g) + 2H_2O(\ell)$; $\Delta_r H°_2 = -622$ kJ/mol

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$; $\Delta_r H°_3 = -285$ kJ/mol

(A) –383 kJ/mol (B) –187 kJ/mol

(C) – 498 kJ/mol (D) None of these

Q.73 How many moles of NaOH must be removed from one litre of aqueous solution to change its pH from 12 to 11 ?

(A) 0.009 (B) 0.01

(C) 0.02 (D) 0.1

Q.74 How many structure isomers of molecular formula $C_5H_{10}O$ give chloroform with NaOCl ?

(A) 2 (B) 3

(C) 4 (D) 5

Q.75 Benzoic acid gives benzene on being heated with X and phenol gives benzene on being heated with Y. Therefore, X and Y are respectively :

(A) soda lime and copper

(B) zinc dust and sodium hydroxide

(C) zinc dust and soda lime

(D) soda lime and zinc dust

BIOLOGY

Q.76 Paraffin wax is *a/an* -

(A) Ester

(B) Acid

(C) Monohydric alcohol

(D) Cholesterol

Q.77 What is the approximate duration of cell cycle for a mammalian cell ?

(A) 90 *min* (B) 24 *hrs*

(C) 24 *days* (D) 12 *hrs*

Q.78 Which of the following events occurs during G_1-phase of the cell cycle ?

(A) *DNA* replication

(B) Growth and normal functioning of cell

(C) *DNA* transcription

(D) Elimination of unwanted cells

Q.79 What will happen, if a large amount of water enters in a plant cell ?

(A) *TP* of cell gets reduced

(B) *TP* opposes the entry of water

(C) Water potential of the cell become more negative

(D) Water potential of the cell increases simultaneously

Q.80 Electrons are transferred by splitting of H_2O through *ETC* during light reaction and reduces -

(A) *NAD* to $NADH + H^+$

(B) *NADPH* to H^+

(C) $NADP^+$ to $NADPH + H^+$

(D) *NAD* to $NADPH + H^+$

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-9

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Mark Questions]

MATHEMATICS

Q.1 The co-ordinates of three points $A(-4, 0)$; $B(2, 1)$ and $C(3, 1)$ determine the vertices of an equilateral trapezium $ABCD$. The co-ordinates of the vertex D are :

(A) (6, 0) (B) (7, 0)

(C) (8, 0) (D) (9, 0)

Q.2 ABC is an equilateral triangle of side 2cm in the xy plane. Segments $\vec{BX}$ and $\vec{CY}$ are drawn perpendicular to the xy plane, both on the same side of the plane. If $BX = 1$ cm & $CY = 3$ cm then the area of the ΔAXY is -

(A) $\sqrt{3}$ (B) 4 (C) $\sqrt{10}$ (D) $2\sqrt{2}$

Q.3 The lines $2x - 3y = 5$ & $8x - 4y = 7$ are diameters of a circle of area 154 sq. units. Then the equation of the circle is :

(A) $x^2 + y^2 + 2x - 2y = 62$

(B) $x^2 + y^2 - 2x + 2y = 47$

(C) $x^2 + y^2 + 2x - 2y = 47$

(D) $x^2 + y^2 - 2x + 2y = 62$

Q.4 The equation of the common tangent in 1st quadrant to the circle $x^2 + y^2 = 9$ and ellipse $\frac{x^2}{25}+\frac{y^2}{5}=1$ is $y = mx + c$, then the value of $4m^2$ is -

(A) 1 (B) 2

(C) 3 (D) 4

Q.5 The reflection of the focus $(a, 0)$ of the parabola $y^2 = 4ax$ through a tangent to the parabola is $(-a, 2a)$, then point of tangency is -

(A) $(a, 2a)$ (B) $(a, -2a)$

(C) $(4a, 4a)$ (D) $(-2a, a)$

Q.6 A set contains $(2n + 1)$ elements. The number of subsets of the set which contains more than n elements is -

(A) 2^{n-1} (B) 2^n

(C) 2^{n+1} (D) 4^n

Q.7 Least integral value of λ for which $(\lambda - 1)x^2 + 8x + (\lambda + 4) > 0$ for all $x \in R$.

(A) 3 (B) 4

(C) 5 (D) 6

Q.8 If the median of a triangle ABC through A is perpendicular to AB then $\frac{\tan A}{\tan B}$ has the value equal to -

(A) $\frac{1}{2}$ (B) 2

(C) -2 (D) $-\frac{1}{2}$

Q.9 Let PQR be a right angled isosceles triangle, right angled at $P(2, 1)$. If the equation of the line QR is $2x + y = 3$, then the equation representing the pair of lines PQ and PR is -

(A) $3x^2 - 3y^2 + 8xy + 20x + 10y + 25 = 0$

(B) $3x^2 - 3y^2 + 8xy + 10x + 15y + 20 = 0$

(C) $3x^2 - 3y^2 + 8xy - 20x - 10y + 25 = 0$

(D) $3x^2 - 3y^2 - 8xy - 10x - 15y - 20 = 0$

Q.10 The locus represented by (x, y) satisfying the condition $\sqrt{(x-1)^2+(y-3)^2}+\sqrt{(x-4)^2+(y+1)^2}=5$ is

(A) A straight line

(B) An ellipse

(C) A line segment

(D) An Infinite part line

Q.11 The number of solutions of $\sin 2x + \cos 4x = 2$ in the interval $(0, 2\pi)$ is -

(A) 0 (B) 2

(C) 3 (D) 4

Q.12 The number of solutions of the equations $\sin 2x + \cos 2x + \sin x + \cos x + 1 = 0$ between $x = 0$ and $x = \frac{\pi}{2}$ is -

(A) 0 (B) 1

(C) 2 (D) None of these

Q.13 Range of $f(x) = \log_{\sqrt[3]{10}}(\sqrt{5}(2\sin x + \cos x) + 5)$ is -

(A) [0, 1] (B) [0, 3]

(C) $\left(-\infty, \frac{1}{3}\right]$ (D) None of these

Q.14 If ΔABC is an isosceles triangle such that $AB = AC = 2BC$. Affixes of A and B are 1 and 9 on the complex plane, then point C is -

(A) $8 + i\sqrt{15}$ (B) $8 + i$

(C) $\frac{49}{8}+\frac{i7\sqrt{15}}{8}$ (D) $7 + 3i$

Q.15 Let z be a complex number having the argument θ, $0 < \theta < \pi/2$ and satisfying the equality $|z - 3i| = 3$. Then $\cot\theta - \frac{6}{z}$ is equal to -

(A) 1 (B) –1

(C) i (D) $-i$

PHYSICS

Q.16 A boy throws a ball with a velocity u at an angle θ with the horizontal. At the same instant he starts running with uniform velocity to catch the ball before it hits the ground.

To achieve this he should run with a velocity of –

(A) $u\cos\theta$ (B) $u\sin\theta$

(C) $u\tan\theta$ (D) $\sqrt{u^2\tan\theta}$

Q.17 A block placed on an inclined plane of slope angle θ slides down with a constant speed. The coefficient of kinetic friction is equal to –

(A) $\sin\theta$ (B) $\cos\theta$

(C) $\tan\theta$ (D) $\cot\theta$

Q.18 If kinetic energy of electron revolving in first orbit of H-atom is E then potential energy of electron revolving in second orbit of He^+ will be -

(A) E (B) $-E$

(C) $+2E$ (D) $-2E$

Q.19 Calculate fraction of Heat supplied to He gas is used in work-done in isobaric process -

(A) $\frac{2}{5}$ (B) 1

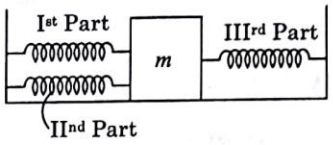
(C) 0 (D) $\frac{3}{5}$

Q.20 If a particle placed at rest suddenly explodes into 2 parts of masses in ratio of 1 : 3, then de-Broglie wavelengths of both fragments will be in the ratio of -

(A) 1 : 2 (B) 1 : 4

(C) 1 : 3 (D) 1 : 1

Q.21 If a spring of force constant k is cut into 3 parts in the ratio of 1 : 1 : 2 in their lengths and these parts are connected as in figure with block of mass m then time period of oscillations will be –



(A) $2\pi\sqrt{\frac{3m}{k}}$ (B) $2\pi\sqrt{\frac{m}{3k}}$

(C) $2\pi\sqrt{\frac{m}{k}}$ (D) None of these

Q.22 A ball is released from the top of a tower of height h metre. It takes T sec to reach the ground. What is the position of the ball in $T/3$ sec ?

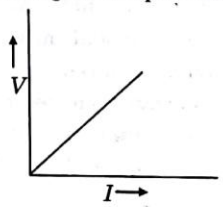
(A) $\frac{h}{9}$ metre from the ground

(B) $7h/9$ metre from the ground

(C) $8h/9$ metre from the ground

(D) $17h/18$ metre from the ground

Q.23 The current -voltage - variation for a wire of copper of length (L) and area (A) is shown in fig. The slope of the line will be -



(A) less if experiment is done at a higher temperature

(B) more if a wire of silver of same dimensions is used

(C) will be doubled if the lengths of the wire is doubled

(D) will be halved if the length is doubled

Q.24 A carbon and an aluminium wire connected in series. If the combination has resistance of 30 ohm at $0°C$, what is the resistance of carbon and aluminium wire at $0°C$ so that the resistance of the combination does not change with temperature -

$[\alpha_C = -0.5 \times 10^{-3}\ (C°)^{-1}$ and $\alpha_{Al} = 4 \times 10^{-3}\ (C°)^{-1}]$

(A) $\frac{10}{3}\Omega, \frac{80}{3}\Omega$ (B) $\frac{80}{3}\Omega, \frac{10}{3}\Omega$

(C) 10 Ω, 80 Ω (D) 80 Ω, 10 Ω

Q.25 If a fish is moving in upward direction in water with 9 m/s is observing a bird which is diving in air with 12 m/s then calculate speed of bird as seen by fish - ($\mu_{water} = 4/3$)

(A) 25 m/s (B) 7 m/s

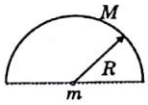
(C) 3 m/s (D) 21 m/s

Q.26 If moving mass of a particle is twice the rest mass then speed of particle is -

(A) $\frac{\sqrt{3}}{2}c$ (B) $\frac{2}{\sqrt{3}}c$

(C) $\frac{c}{2}$ (D) None of these

Q.27 A particle of mass m is placed on the centre of a fixed uniform semi-circular ring of radius R and mass M as shown. Then work required to displace the particle slowly from centre of ring to infinity is : (Assume only gravitational interaction of ring and particle)



(A) $\frac{GMm}{R}$ (B) $-\frac{GMm}{R}$

(C) $\frac{GMm}{\pi R}$ (D) $-\frac{GMm}{\pi R}$

Q.28 The intensity of radiation emitted by the the sun has its maximum value at a wavelength of 510 nm and that emitted by the north star has the maximum value at 350 nm. If these stars behave like blockbodies, then the ratio of the surface temperature of the sun and the north star is -

(A) 1.46 (B) 0.69

(C) 1.21 (D) 0.83

Q.29 Three equal and similar charges are placed at $(-a, 0, 0)$, $(0, 0, 0)$ and $(+a, 0, 0)$. What is the nature of equilibrium of the charge at the origin-

(A) Stable when moved along the Y-axis

(B) Stable when moved along Z-axis

(C) Stable when moved along X-axis

(D) Unstable in all of the above cases

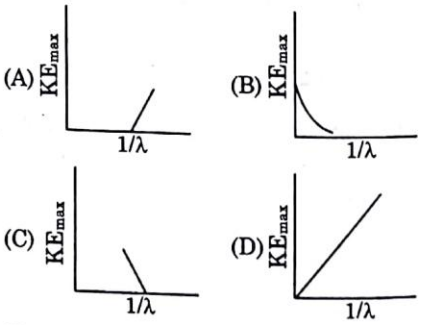
Q.30 An electric field can deflect -

(A) X-rays (B) Neutrons

(C) α-particles (D) γ-rays

CHEMISTRY

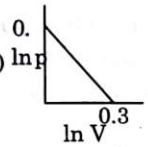
Q.31 Maximum kinetic energy of photoelectron is plotted versus $\frac{1}{\lambda}$ where λ is the wavelength of incident light. Identify the correct graph.

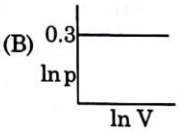


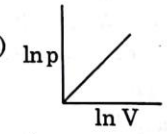
Q.32 The mass of 90% pure NaOH needed is order to prepare 900 mL of 0.1 M NaOH solution is :

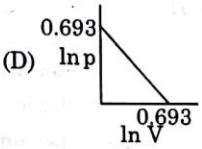
(A) 0.4 g (B) 0.36 g (C) 4 g (D) 3.6 g

Q.33 Which of the following correctly represents an isotherm (nRT = 2) ?

(A) 

(B) 

(C) 

(D) 

Q.34 How many electrons in the ground state of neon have $(l + m_l) = 0$?

(A) 2 (B) 4

(C) 6 (D) 3

Q.35 1 mol $A_{2(g)}$ was kept in 1L flask to achieve the following equilibrium

$A_{2(g)} \rightleftharpoons 2A_{(g)}$ $K_c = 4 \times 10^6$

The number of A_2 molecules at equilibrium are (approx.)

(A) 6.02×10^{20} (B) 6.02×10^{21}

(C) 6.02×10^{17} (D) 6.02×10^{16}

Q.36 The number of sigma (σ) bonds and pi (π) bonds in the must stable lewis of Benzonitrile are :

(A) $12\sigma, 5\pi$ (B) $13\sigma, 5\pi$

(C) $8\sigma, 5\pi$ (D) $13\sigma, 4\pi$

Q.37 Copper utensils turn greenish in moist environment due to the formation of :

(A) $CuCl_2$ (B) CuO

(C) $Cu(OH)_2.CuCO_3$ (D) $CuSO_4$

Q.38 What is the value of N in the given chemical formula of blue vitriol $CuSO_4.NH_2O$

(A) 2 (B) 4

(C) 5 (D) 6

Q.39 Correct order of electronegative difference between bonded atom is

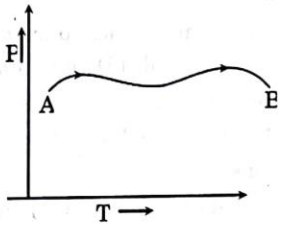
(A) $NaCl < AlCl_3 < MgCl_2$

(B) $AlCl_3 < MgCl_2 < NaCl$

(C) $NaCl < MgCl_2 < AlCl_3$

(D) $MgCl_2 < NaCl < AlCl_3$

Q.40 The P-T graph as given below was observed for a process on an ideal gas, which of the following statement is true.



(A) w = +ve, ΔH = +ve

(B) w = –ve, ΔH = –ve

(C) w = –ve, ΔH = +ve

(D) w = +ve, ΔH = –ve

Q.41 In conversion of 2-butanone to propanoic acid which reagent is used.

(A) NaOH, $NaI/H^{\oplus}$ (B) Fehling solution

(C) NaOH, $I_2/H^{\oplus}$ (D) Tollen's reagent

Q.42 Pyridine is less basic than triethylamine because :

(A) Pyridine has aromatic character

(B) Nitrogen in pyridine is sp^2 hybridised

(C) Pyridine is a cyclic system

(D) In pyridine, lone pair of nitrogen is delocalised

Q.43 Formation of alcohol by oxymercuration demercuration of alkenes :

(A) Involves carbocations and rearrangement

(B) Involves carbanions and rearrangement

(C) Is stereospecific

(D) Does not involve rearrangement and carbocation

Q.44 Number of H-bond between base pairs A and T and the base pair G and C are respectively.

(A) 2 and 2 (B) 2 and 3

(C) 3 and 2 (D) 3 and 3

Q.45 Which of the statements about "Denaturation" given below are correct ?

Statements :

(1) Denaturation of proteins causes loss of secondary and tertiary structures of the protein

(2) Denaturation leads to the conversion of double strand of DNA into single strand

(3) Denaturation affects primary structure which gets distorted

Options :

(A) (2) and (3) (B) (1) and (3)

(C) (1) and (2) (D) (1), (2) and (3)

BIOLOGY

Q.46 In monocotyledonous plants e.g. wheat the primary root is short lived and is replaced by a large number of roots. These roots originate from the base of the stem and constitute

(A) Prop roots (B) Pneumatophores

(C) Napiform (D) Fibrous roots

Q.47 Energy currency (or energy reservoir) of the cell is

(A) AMP (B) ATP

(C) RNA (D) DNA

Q.48 The number of molecules of pyruvic acid formed from one molecule of glucose at the end of glycolysis is

(A) 1 (B) 2

(C) 3 (D) 4

Q.49 85–90% of all photosynthesis of the world is carried out by -

(A) Shrubs

(B) Herbs

(C) Oceanic algae

(D) Trees with large branches

Q.50 The most important functions of leaves are –

(A) Photosynthesis and respiration

(B) Photosynthesis and transpiration

(C) Transpiration and respiration

(D) Respiration and digestion

Q.51 A cell is plasmolysed after being kept in a hypertonic solution. What will be present between cell wall and plasmalemma

(A) Isotonic solution

(B) Hypertonic solution

(C) Air

(D) Hypotonic solution

Q.52 When a grape is placed in concentrated suger solution, then it will show

(A) Endosmosis (B) Exosmosis

(C) Imbibition (D) None of these

Q.53 If two individuals with heterozygous A and B blood marries, then possibility of genotypes in their progeny are

(A) Only $I^0 I^0$ (B) Only $I^A I^B$

(C) $I^A I^0$ and $I^B I^0$ (D) All the above

Q.54 Which one of the following is a matching pair of the kind of excretory organ and an animal

(A) Urinary tubules-Scorpion

(B) Nephridia-Frog

(C) Malpighian tubules-House lizard

(D) Green glands-Prawn

Q.55 Read the following statements and select the correct one

(A) The H^+ released from carbonic acid combines with haemoglobin to form haemoglobinic acid

(B) Oxyhaemoglobin of erythrocytes is alkaline

(C) More than 70% of carbon dioxide is transferred from tissue to the lungs in the form of carbamino compounds

(D) In lungs, the oxygen from the alveolus reaches the blood through active transport

Q.56 The haemoglobin a human foetus

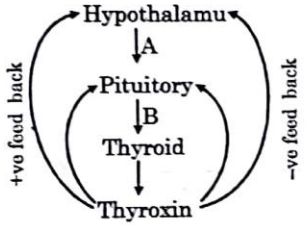
(A) has a lower affinity for oxygen than that of the adult

(B) its affinity for oxygen is the same as that of an adult

(C) has only two protein subunits instead of four

(D) has a higher affinity for oxygen than that of an adult

Q.57 Here is the scatch of secretion of hormone with its regulation. What A and B are and how does –ve and +ve feed back control operate.



(A) A = TRF, B = T.S.H, +ve control when low thyroxin level in blood and –ve control when high thyroxin level in blood

(B) A = TIF, B = T.S.H, +ve control when high thyroxin level in blood and –ve control when low thyroxin level in blood

(C) A = T.S.H, B = Calcitonin, +ve control when low calcitonin in blood and –ve control when high calcitonin in blood

(D) A = Oxytocin, B = Thyroxin, +ve control when high calcium in blood –ve when low calcium in blood

Q.58 Which of the following are required in minimum amount by -

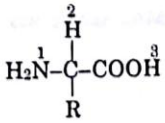
(A) Iron, idoine, carbon, manganese, copper, O_2

(B) Iron, iodine, manganese, copper zinc, fluorine

(C) Iron, iodine, manganese, zinc, hydrogen

(D) Nitrogen, oxygen, zinc, fluorine

Q.59 An Amino acid has the following structure :



Which two group combine to form the peptide linkage ?

(A) 1–3 (B) 2–3 (C) 1–4 (D) 1–2

Q.60 Given below is the scatch of hearing. Find out the correct sequence of hearing or transmision of sound waves -

(A) External auditory canal → Tympanic membrane → Malleus → Incus → Stapes → Fenestra ovalis → scala vestibuli → Helicotrema → Scala media → organ of corti → Auditory nerve → Posteiror Colliculi → Temporal lobe of cerebrum

(B) External auditory canal → Tympanic membrane → Incus → Malleus → Stapes → Fenestra ovalis → scala vestibuli → Helicotrema → Scala media → organ of corti → Auditory nerve → Posterior colliculi → Temporal lobe of cerebrum

(C) External auditory canal → Tympanic membrane → Incus → Stapes → Malleus → Fenestra ovalis → scala vestibuli → Helicotrema → Scala media → organ of corti → Auditory nerve → Posterior colliculi → Temporal lobe of cerebrum

(D) External auditory canal → Tympanic membrane → Incus → Stapes → Malleus → Fenestra ovalis → scala vestibuli → Scala media → Helicotrema → organ of corti → Auditory nerve → Posterior colliculi → Temporal lobe of cerebrum

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 If the sum $\sum_{k=1}^{\infty} \frac{1}{(k+2)\sqrt{k}+k\sqrt{k+2}} = \frac{\sqrt{a}+\sqrt{b}}{\sqrt{c}}$ where $a, b, c \in N$ and lie in [1, 15], then $a+b+c$ equals to-

(A) 6 (B) 8

(C) 10 (D)11

Q.62 Let $E = (2n+1)(2n+3)(2n+5)...(4n-3)(4n-1)$ where $n > 1$, then $2^n E$ is divisible by

(A) ${}^{2n}C_n$ (B) ${}^{4n}C_{2n}$

(C) ${}^{2n}C_{n/2}$ (D) ${}^{4n}C_{n/2}$

Q.63 The total number of positive integral solution of $abc = 24$ is -

(A) 36 (B) 90

(C) 120 (D) 30

Q.64 If $x + \frac{1}{x} = 1$ and $p = x^{1000} + \frac{1}{x^{1000}}$ and q be the digit at unit place in the number $2^{2n}+1$, $n \in N$ and $n > 1$ then $p+q =$

(A) 8 (B) 6

(C) 7 (D) None of these

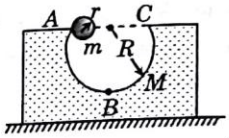
Q.65 If α, β be the roots of $x^2 - a(x-1) + b = 0$ then the value of $\frac{1}{\alpha^2 - a\alpha} + \frac{1}{\beta^2 - b\beta} + \frac{2}{a+b}$ is -

(A) $\frac{4}{a+b}$ (B) $\frac{1}{a+b}$

(C) 0 (D) None of these

PHYSICS

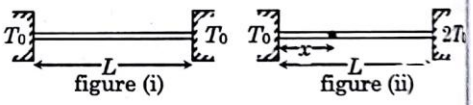
Q.66 A block of mass M with a semicircular track of radius R rests on a horizontal frictionless surface. A uniform cylinder of radius r and mass m is released from rest from the top point A. The cylinder slips on the semicircular frictionless track. The distance travelled by the block when the cylinder reaches the point B is :



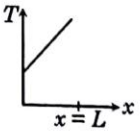
(A) $\frac{M(R-r)}{M+m}$ (B) $\frac{m(R-r)}{M+m}$

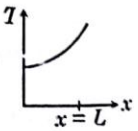
(C) $\frac{(M+m)R}{M}$ (D) None

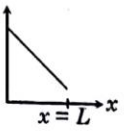
Q.67 A uniform rod of length L at room temperature T_0 just fits between two walls also at room temperature T_0, as shown in figure (i). Now the left wall is maintained at room temperature T_0 and right wall is maintained at temperature $2T_0$ as shown in figure (ii).

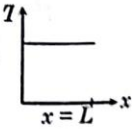


After the rod has achieved thermal steady state, the variation of tension in rod shown in figure (ii) as a function of distance x from left end is best represented by

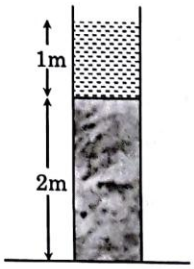
(A)


(B)


(C)


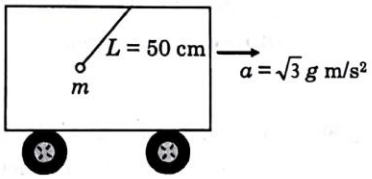
(D)


Q.68 1 m height of water level is maintained in a container which is placed on a platform of height 2m. A hole is punched at a height h from the ground. For which value of h given in options, the water falls at maximum distance from the base ?



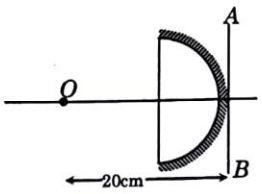
(A) 1.5 m (B) 2.01 m
(C) 2.25 m (D) 2.50 m

Q.69 A simple pendulum 50 cm long is suspended from the roof of a cart accelerating in the horizontal direction with constant acceleration $\sqrt{3}$ gm/s². The period of small oscillations of the pendulum about its equilibrium position is ($g = \pi^2$ m/s²)



(A) 1.0 sec (B) $\sqrt{2}$ sec
(C) 1.53 sec (D) 1.68 sec

Q.70 A point object is placed at a distance of 20 cm from a thin plane convex lens of focal length 15 cm (n = 1.5). Now the curved surface is silvered. The image will be formed at :



(A) 60 cm left of AB
(B) 30 cm left of AB
(C) $\frac{20}{7}$ cm left of AB
(D) 60 cm right of AB

CHEMISTRY

Q.71 Which of the following orders is correct in respect of bond dissociation energy ?
(A) $N_2^+ > N_2^-$ (B) $O_2^+ > O_3$
(C) $NO^+ > NO$ (D) All of these

Q.72 If wave functions, $\psi(r, \theta, \phi)$ of $2s$ and $2p_z$ electrons in a hydrogen atom are given by

$$\psi(2s) = K_1\left(2 - \frac{r}{a_0}\right)e^{-r/a_0}$$

and $\psi(2p_z) = K_2\left(\frac{r}{a_0}\right)e^{-r/a_0}\cos\theta$,

where a_0 = 53 pm, and let constants $k_1 = k_2$. If the probability of finding the electron in 2s orbital in a small spherical volume of radius r = r_0($r_0 << a_0$) around $r = a_0$ is P_1 and of electron in $2p_z$ orbital in same spherical volume around $r = a_0$ at $\theta = 30°$ is P_2 then :
(A) $P_1 > P_2$
(B) $P_1 = P_2$
(C) $P_1 < P_2$
(D) cannot be predicted

Q.73 If HA + NaOH → NaA + H_2O $\Delta H = -12$ kcal and HB + NaOH → NaB + H_2O $\Delta H = -11$ kcal then equimolar solution of which acid has higher pH -
(A) HA
(B) HB
(C) both have same pH
(D) information insufficient

Q.74 A compound with molecular formula $C_4H_{10}O_4$ on acylation with acetic anhydride gives a compound with molecular formula $C_{12}H_{18}O_8$. How many hydroxy groups are present in the compound ?
(A) One (B) Two
(C) Three (D) Four

Q.75 Match the compounds given in List-I with List-II and select the suitable option using the code given below :

List-I		List-II	
(a)	Benzaldehyde	(i)	Phenolphtalein
(b)	Phthalic anhydride	(ii)	Benzoin condensation
(c)	Phenyl benzoate	(iii)	Oil of wintergreen
(d)	Methyl salicylate	(iv)	Fries rearrangement

Code :	(a)	(b)	(c)	(d)
(A)	(iv)	(i)	(iii)	(ii)
(B)	(iv)	(ii)	(iii)	(i)
(C)	(ii)	(iii)	(iv)	(i)
(D)	(ii)	(i)	(iv)	(iii)

BIOLOGY

Q.76 Select incorrect statement *w.r.t.* plasma membrane?

(A) Proteins can move laterally within the overall bilayer

(B) Proteins can be distinguished on the basis of ease of extraction

(C) Cholesterol is present in all living organisms

(D) Protein constitute 52 percent and lipid 40 percent for *RBC*

Q.77 Correctly match the events of cell cycle with the respective stage of substage of their occurrence?

Column-I	Column-II
a. Equatorial plate	(i) Anaphase-II
b. Diplotene	(ii) Synapsis
c. Centromeric splitting	(iii) Metaphase
d. Zygotene	(iv) Chiasmata

(A) *a*(iii), *b*(iv), *c*(i), *d*(ii)

(B) *a*(i), *b*(iv), *c*(iii), *d*(ii)

(C) *a*(iii), *b*(ii), *c*(i), *d*(iv)

(D) *a*(ii), *b*(i), *c*(iii), *d*(iv)

Q.78 Select an incorrect match?

(A) Calcium - Synthesis of middle lamella

(B) Zinc - Needed in auxin synthesis

(C) Iron - Chlorophyll ring structure

(D) Sulphur - Constituent of biotin

Q.79 Cyclic photophosphorylation is different from non-cyclic pathway in ?

(A) Producing *ATP* only

(B) Being sensitive against *DCMU* and *CMU*

(C) Producing *ATP* and evolution of O_2

(D) Having cytochrome $b_6 - f$ complex as a component

Q.80 How many *ATP* and *NADPH* molecules are required to produce 2 glucose molecules through C_3 cycle ?

(A) 60 *ATP*, 24 *NADPH*

(B) 36 *ATP*, 24 *NADPH*

(C) 24 *ATP*, 36 *NADPH*

(D) 18 *ATP*, 12 *NADPH*

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-10

Stream – SA

Time : 3 Hrs **Max. Marks : 100**

GENERAL INSTRUCTIONS :

- The test booklet consists of 80 questions.
- There are two parts in the question paper.
- The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART - I :

Mathematics	:	Question No. 1 to 15 consist of ONE (1) mark for each correct response.
Physics	:	Question NO. 16 to 30 consist of ONE (1) mark for each correct response.
Chemistry	:	Question No. 31 to 45 consist of ONE (1) mark for each correct response.
Biology	:	Question No. 46 to 60 consist of ONE (1) mark for each correct response.

PART - II

Mathematics	:	Question No. 61 to 65 consist of TWO (2) marks for each correct response.
Physics	:	Question No. 66 to 70 consist of TWO (2) marks for each correct response.
Chemistry	:	Question No. 71 to 75 consist of TWO (2) marks for each correct response.
Biology	:	Question No. 76 to 80 consist of TWO (2) marks for each correct response.

PART-I [One Marks Questions]

MATHEMATICS

Q.1 Let $A = \{x/x$ is a prime number and $x < 30\}$. The number of different rational numbers whose numerator and denominator belong to A, is -

(A) 90 (B) 180

(C) 91 (D) 30

Q.2 The number of values of k for which $[x^2 - (k-2)\,x + 0^2]\,[x^2 + kx + (2k-1)]$ is a perfect square is -

(A) 1 (B) 2

(C) 0 (D) None of these

Q.3 If $N = 7^{p+4} \cdot 5^q \cdot 2^3$ is a perfect cube, where p and q are positive integers, the smallest possible value of $p + q$ is -

(A) 5 (B) 2

(C) 8 (D) 6

Q.4 Triangle ABC is isosceles with $AB = AC$ and $BC = 65$ cm. P is a point on BC such that the perpendicular distance from P at AB and AC are 24 cm. and 36 cm respectively. The area of triangle ABC in sq cm is -

(A) 1254 (B) 1950

(C) 2535 (D) 5070

Q.5 The sum of square of the length of the chords intercepted by the line $x + y = n$; $n \in N$ on the circle $x^2 + y^2 = 4$ is -

(A) 11 (B) 22

(C) 33 (D) None of these

Q.6 If $1^2 + 2^2 + 3^2 + ... + (2003)^2 = (2003)(4007)(334)$ and$(1)(2003) + 2.(2002) + 3.(2001) + ... + (2003)(A) = (2003)(334)x$, then x equals -

(A) 2005 (B) 2004

(C) 2003 (D) 2001

Q.7 The straight lines represented by $(y - mx)^2 = a^2(1 + m^2)$ and $(y - nx)^2 = a^2(1 + n^2)$

(A) rectangle (B) trapezium

(C) rhombus (D) None of these

Q.8 Point (x, y) lies on line $2x + 3y = 6$. Then smallest value of $\sqrt{x^2 + y^2}$ is -

(A) $6\sqrt{13}$ (B) $\frac{6}{13}$

(C) $\frac{6}{\sqrt{13}}$ (D) None of these

Q9. In a triangle ABC, if the sides a, b, c are roots of $x^3 - 11x^2 + 38x - 40 = 0$, then $\sum \frac{\cos A}{a} =$

(A) 3/4 (B) 4/3

(C) 16/9 (D) 9/16

Q.10 The locus of point $P(x, y)$ such that $\sqrt{x^2 + y^2 + 8y + 16} - \sqrt{x^2 + y^2 - 6x + 9} = 5$ is -

(A) a circle

(B) a finite line segment

(C) a parabola

(D) infinite ray

Q.11 Number of values of a for which for the system $2^{|x|} + |x| = y + x^2 + a$ and $x^2 + y^2 = 1$ has only one solution where a,x,y are real is -

(A) 1

(B) 2

(C) finite but more than two

(D) infinite

Q.12 If α, β be the roots of $ax^2 + bx + c = 0$; γ, δ be the roots of $px^2 + qx + r = 0$; and D_1, D_2 the respective discriminants. If $\alpha, \beta, \gamma, \delta$ are in $A.P.$then $D_1 : D_2 =$

(A) $\frac{a^2}{b^2}$ (B) $\frac{a^2}{p^2}$

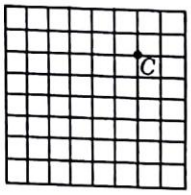
(C) $\frac{b^2}{q^2}$ (D) $\frac{c^2}{r^2}$

Q13. If S_r denotes the sum of r terms of an AP and $\frac{S_a}{a^2} = \frac{S_b}{b^2} = c$ then S_c is

(A) c^3 (B) c/ab

(C) abc (D) $a + b + c$

Q.14 The number of possible rectangles in adjoining figure none of whose vertex is 'C', will be-



(A) 964 (B)1100

(C) 1232 (D) 1035

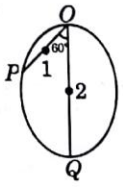
Q.15 If the equation $(3x)^2 + (27 \times 3^{1/p} - 15)x + 4 = 0$ has equal roots, then $p =$

(A) 0 (B) 2

(C) –1/2 (D) None of these

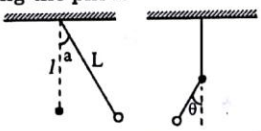
PHYSICS

Q.16 Two particles 1 and 2 are allowed to descend on two frictionless chords OP and OQ. The ratio of the speeds of particles 1 and 2 respectively when they reach on the circumference is -



(A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) 1 (D) $\frac{1}{2\sqrt{2}}$

Q.17 A simple pendulum consisting of a mass M attached in a string of length L is released from rest at an angle α. A pin is located at a distance l below the pivot point. When the pendulum swings down, the string hits the pin as shown in the figure. The maximum angle θ which string makes with the vertical after hitting the pin is -



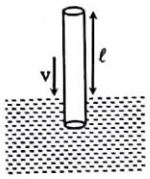
(A) $\cos^{-1}\left[\frac{L\cos\alpha+l}{L+l}\right]$ (B) $\cos^{-1}\left[\frac{L\cos\alpha+l}{L-l}\right]$

(C) $\cos^{-1}\left[\frac{L\cos\alpha-l}{L-l}\right]$ (D) $\cos^{-1}\left[\frac{L\cos\alpha-l}{L+l}\right]$

Q.18 A wind powered generator converts wind energy into electric energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to -

(A) v (B) v^2 (C) v^3 (D) v^4

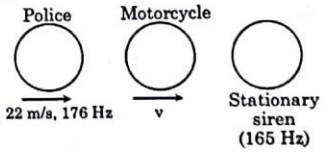
Q.19 An open pipe of sufficient is dipping in water with a speed v vertically. If at any instant ℓ is length of tube above water. Then the rate at which fundamental frequency of pipe changes, is -



(A) $cv/2\ell^2$ (B) $cv/4\ell^2$

(C) $c/2v^2\ell^2$ (D) $c/4v^2l^2$

Q.20 A police car moving at 22 m/s chases a motorcyclist. The police man sounds his horn at 176 Hz, while both of them move towards a stationary siren of frequency 165 Hz. Calculate the speed of the motorcycle. If it is given that the motorcyclist does not observe any beats (speed of sound = 330 m/s)



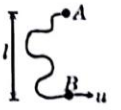
(A) 33 m/s (B) 22 m/s

(C) zero (D) 11 m/s

Q.21 The centre of mass of a non-uniform rod of length L whose mass per unit length $\lambda = \frac{Kx^2}{L}$, where K is a constant and x is the distance from one end is -

(A) $\frac{3L}{4}$ (B) $\frac{L}{8}$ (C) $\frac{K}{L}$ (D) $\frac{3K}{L}$

Q.22 Two particles A and B each of mass m are attached by a light inextensible string of length $2l$. The whole system lies on a smooth horizontal table with B initially at a distance l from A. The particle at end B is projected across the table with speed u perpendicular to AB. Velocity of ball A just after the string is taut, is



(A) $\frac{u\sqrt{3}}{4}$ (B) $u\sqrt{3}$ (C) $\frac{u\sqrt{3}}{2}$ (D) $\frac{u}{2}$

Q.23 A solid sphere rolls down two difference inclined planes of same height but of different inclinations. In both cases

(A) the speed and time of descent will be same

(B) the speed will be same but time of descent will be different

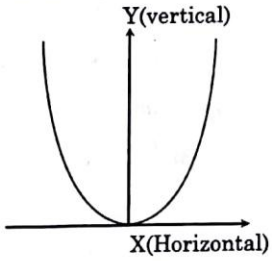
(C) the speed will be different but time of descent will be same

(D) speed and time of descent both the different

Q.24 Pressure P, volume V and temperature T of a certain material are related by $P=\frac{\alpha T^2}{V}$. Here, α is a constant. The work done by the material when temperature changes from T_0 to $2T_0$ while pressure remains constant is -

(A) $6\alpha T_0^3$ (B) $\frac{3}{2}\alpha T_0^2$ (C) $2\alpha T_0^2$ (D) $3\alpha T_0^2$

Q.25 A parabolic bowl with its bottom at origin has the shape $y= x^2/20$. Here x and y are in metres. The maximum height at which a small mass m can be placed on the bowl without slipping (coefficient of static friction is 0.5) is



(A) 2.5 m (B) 1.25 m

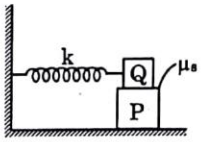
(C) 1.0 m (D) 4.0 m

Q.26 A long horizontal rod has a bead which can slide along its length and is initially placed at a distance L from one end A of the rod. The rod is set in angular motion about A with a constant angular acceleration α. If the coefficient of friction between the rod and bead is μ, and gravity is neglected, then the time after which the bead starts slipping is -

(A) $\sqrt{\frac{\mu}{\alpha}}$ (B) $\frac{\mu}{\sqrt{\alpha}}$

(C) $\frac{1}{\sqrt{\mu\alpha}}$ (D) Infinitesimal

Q.27 A block P of mass m is placed on a horizontal frictionless plane. A second block of same mass m is placed on it and is connected to a spring of spring constant k, the two blocks are pulled by distance A. Block Q oscillates without slipping. What is the maximum value of frictional force between the two blocks



(A) kA/2 (B) kA

(C) $\mu_s$mg (D) zero

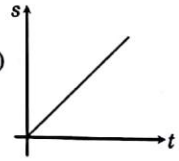
Q.28 A point mass starts moving in straight line with constant acceleration a from rest at $t = 0$. At time $t = 2s$, the acceleration changes the sign, remaining the same in magnitude. The mass returns to the initial position at time $t = t_0$ after start of motion. Here, t_0 is

(A) $4s$ (B) $(4 + 2\sqrt{2})s$

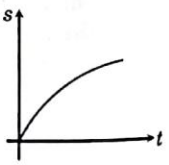
(C) $(2+2\sqrt{2})s$ (D) $(4 + 4\sqrt{2})s$

Q.29 One stone is dropped from a tower from rest and simultaneously another stone is projected vertically upwards from the tower with some initial velocity. The graph of the distance(s) between the two stones varies with time (t) as (before either stone hits the ground)

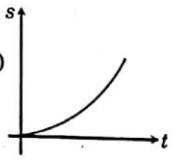
(A)



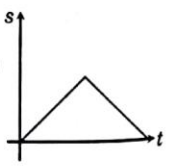
(B)



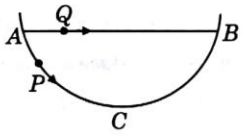
(C)



(D)



Q.30 A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal component of its velocity is v. A bead Q of the same mass as P is ejected from A at $t = 0$ along the horizontal string AB, with the speed v. Friction between the bead and the string may be neglected. Let t_P and t_Q be the respective times taken by P and Q to reach the point B. Then



(A) $t_P < t_Q$

(B) $t_P = t_Q$

(C) $t_P > t_Q$

(D) $\frac{t_P}{t_Q} = \frac{\text{length of arc } ACB}{\text{length of chord } AB}$

CHEMISTRY

Q.31 Which of the following will not have same general formula :

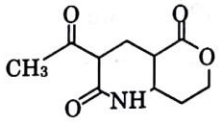
(A) Alkynes and alkaldienes

(B) Carboxylic acid and esters

(C) Alkanenitriles and alkynamines

(D) Alcohol and aldehyde

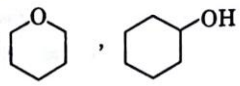
Q.32 In the given compound which function group is absent ?



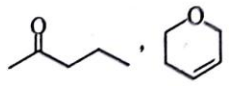
(A) Ketone (B) Ether

(C) Amide (D) Ester

Q.33 Which of the following pairs contain functional isomers ?

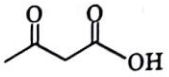
(A) 

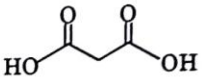
(B) 

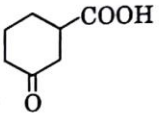
(C) 

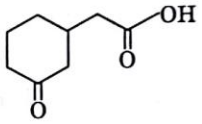
(D) 

Q.34 In which of the following compound, carbon of principal functional group cannot be taken in parent chain ?

(A) 

(B) 

(C) 

(D) 

Q.35 Identify the cyclic hydrocarbon having highest unsaturation that gives only 2 structural monochloro products after hydrogenation followed by monochlorisation ?

(A) 

(B) 

(C) 

(D) 

Q.36 Which of the following compound will not give 2, 3-Dimethylpentane on catalytic hydrogenation ?

(A) 2-Isopropylbut-1-ene

(B) 2,3-Dimethylpent-2-ene

(C) 2,4-Diemethylpent-1-ene

(D) 3,4-Dimethylpent-1-ene

Q.37 Consider the balanced reaction

$Br_2 + 3Cl_2 \longrightarrow 2BrCl_3$ (Br = 80, Cl = 35.5)

What can be concluded from the coefficients of species in this balanced equation ?

(A) For this reaction 1 g of Br_2 must be mixed with exactly 3 g of Cl_2

(B) For this reaction 1 mole of Br_2 must be mixed with exactly 3 mole of Cl_2

(C) Mole ratio of Br_2, Cl_2 and $BrCl_3$ is 1 : 3 : 2 during a chemical reaction at any instant (excluding any negative sign)

(D) The ratio of change in number of moles of Br_2, Cl_2 and $BrCl_3$ is 1 : 3 : 2 (excluding any negative sign)

Q.38 The correct order of decreasing oxidation number of P in compounds is :

(A) $H_3PO_3 < H_4P_2O_7 < H_3PO_2 < P_4$

(B) $H_4P_2O_7 < H_3PO_3 < H_3PO_2 < P_4$

(C) $H_3PO_3 < H_4P_2O_7 < P_4 < H_3PO_2$

(D) $H_4P_2O_7 < P_4 < H_3PO_2 < H_3PO_3$

Q.39 For which of the following species sum of spin quantum numbers of all electrons comes out to be zero.

(A) Cr^+ (Z = 24) (B) Sc (Z = 21)

(C) Cu^+ (Z = 29) (D) Na (Z = 11)

Q.40 Which of the following order is **Incorrect** :

(A) $O^{2-} < F^- < Na^+ < Mg^{2+}$ increasing $Z_{effective}$

(B) $Mg^{++} < Na^+ < O^{--} < F^-$ increasing size

(C) $O^{2-} < F^- < Na^+ < Mg^{2+}$ increasing I.E.

(D) $O^{2-} < F^- < Na+ < Mg^{+2}$ decreasing size

Q.41 **Given :**

$LiCl \cdot 3NH_3(s) \rightleftharpoons LiCl.NH_3(s) + 2NH_3(g)$;

$K_P = 9$ atm^2

1 mole of $LiCl \cdot NH_3(s)$ is placed in an 82.1 L vessel that contains Ne at 3 atm pressure. As some NH_3 is added to the system maintained at 300 K :

(A) $LiCl \cdot 3NH_3(s)$ begins to form due to backward reaction as per given equation

(B) 2 mole NH_3 is required to be added for complete conversion of $LiCl.NH_3(s)$ to $LiCl.3NH_3(s)$

(C) Pressure in the vessel remains constant at 3 atm

(D) No $LiCl.3NH_3(s)$ is formed till the pressure in vessel increases to 6 atm

Q.42 Bubbling CO_2 through which of the following will produce a white precipitate :

(A) $NaAlO_2$ (B) Na_2CO_3

(C) NaOH (D) $MgSO_4$

Q.43 Out of the following which is non-planar ?

(A) XeF_4 (B) H_2O

(C) ClF_3 (D) None of these

Q.44 Enthalpy of neutralisation of CH_3COOH by NaOH is –50.6 kJ/mol and the heat of nuetralisation of a strong acid with NaOH is –55.9 kJ/mol. The value of ΔH for the ionisation of CH_3COOH is -

(A) 3.5 kJ/mol (B) 4.6 kJ/mol

(C) 5.3 kJ/mol (D) 6.4 kJ/mol

Q.45 What is the increasing order of equivalent weights of following oxidising agents ?

(i) $KMnO_4 \longrightarrow Mn^{+2}$

(ii) $K_2Cr_2O_7 \longrightarrow Cr^{3+}$

(iii) $KClO_3 \longrightarrow Cl^-$

[Atomic wt. K = 39, Mn = 55, Cr = 52, Cl = 35.5, O = 16]

(A) $KClO_3 < KMnO_4 < K_2Cr_2O_7$

(B) $K_2Cr_2O_7 < KMnO_4 < KClO_3$

(C) $KMnO_4 < K_2Cr_2O_7 < KClO_3$

(D) $KClO_3 < K_2Cr_2O_7 < KMnO_4$

BIOLOGY

Q.46 Number of *RBCs* per unit volume of blood is likely to be higher in a person living at high altitudes, because -
(A) Air clean and unpolluted
(B) More sunshine is available
(C) Air is less dense
(D) Vegetation gives out more O_2

Q.47 Hamburger shift is also called -
(A) Hydrogen shift (B) HCO_3 shift
(C) Chloride shift (D) Na shift

Q.48 *CCK* and secretion secreted by :
(A) Stomach (B) Ileum
(C) Duodenum (D) Colon

Q.49 Insulin differs from Growth hormone in :
(A) Increases activity of *m-RNA* and Ribosomes
(B) Increase the permeability of cell membrane
(C) Affects metabolism of fats by inducing lipogenesis
(D) Increasing protein synthesis

Q.50 Enamel of teeth is secreted by :
(A) Ameloblast (B) Odontoblast
(C) Osteoblast (D) Osteoclast

Q.51 During prolonged fasting, in what sequence are the following organic compounds used up by the body
(A) First carbohydrates, next fats and lastly proteins
(B) First fats, next carbohydrates and lastly proteins
(C) First carbohydrates, next proteins and lastly lipids
(D) First proteins, next lipids and lastly carbohydrates

Q.52 Which of the following statements is true ?
(A) *GHP* is due to plasma proteins
(B) *BCOP* is due to narrower afferent arteriole
(C) Fall in blood pressure reduce *EFP*
(D) Fall in blood pressure increases both *EFP* and *CHP*

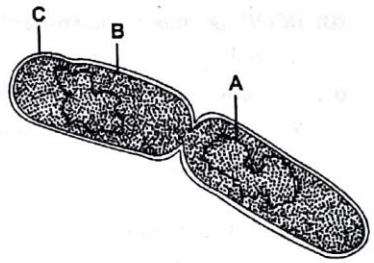
Q.53 Damaged skeletal muscle -
(A) Regenerates by meiotic division
(B) Regenerates only in young children
(C) Can never regenerates
(D) All of the above

Q.54 Which statement is incorrect :
(A) Simple epithelium lines body cavities, ducts and tubes
(B) Squamous epithelium is found in the walls of blood vessels and air sacs of lungs
(C) Main function of cuboidal epithelium is filteration and diffusion
(D) Columnar epithelium is mainly present on the inner surface of hollow organs

Q.55 What is common between an earthworm, a cockroach and a centipede ?
(A) Haemocoel
(B) Metamerism
(C) Sexual dimorphism
(D) Chitinous exoskeleton

Q.56 Which taxonomic aid is useful as a quick referral system in taxonomic studies?
(A) Museum
(B) Botanical garden
(C) Taxonomic key
(D) Herbarium

Q.57 Identify the given labels *A*, *B* and *C* in the figure given below ?



(A) Mesosome, Cell membrance, Glycocalyx
(B) Mesosome, Cell mebrance, Cell wall
(C) ssDNA, Glycocalyx, Cell wall
(D) dsDNA, Cell membrance, Cell wall

Q.58 Find the one which is not concerned with haplodiplontic life cycle ?
(A) Organisms where life cycle phases are multicelled and always free living
(B) Bryophtyes
(C) Pteriodophytes
(D) Brown algae like Ectocarpus and Kelps

Q.59 Ribosomes in prokaryotes
a. Are 70 *S* type
b. From polysomes
c. Are not surrounded by any membrance
d. Have 23 *S rRNA* in small subunit
(A) All are correct
(B) Only *d* is incorrect
(C) Both *c* and d are incorrect
(D) Only *a* is correct

Q.60 Specific site for attachment of spindle fibres to the chromosome is?
(A) Centrosome (B) Kinetochore
(C) Centriole (D) Blepheroplast

PART-II [Two Marks Questions]

MATHEMATICS

Q.61 The remainder when
$x^{57} + x^{40} + x^{21} + x^{10} + x$ is divided by $x^3 - x$ is
(A) $3x^2 + 2x$ (B) $2x^2 + 3x$
(C) $2x + 3$ (D) 0

Q.62 The number of integral solution of
$\left(1+\frac{1}{b}\right)\left(1+\frac{1}{c}\right) = 2$ is -
(A) 1 (B) 2 (C) 4 (D) 0

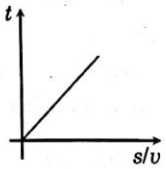
Q.63 The sum of all coefficient of those terms in the expansion of $(a + b + c + d)$ which contain b but not c is :
(A) 211 (B) $4^5 - 3^5$
(C) $3^5 - 2^5$ (D) 10^5

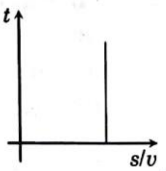
Q.64 Ashu and Manoj start running simultaneously from the ends *A* and *B* respectively, of a straight track of length 800 m, with speeds that are in the ratio 5 : 3. Whenever Ashu reaches either of the ends, he turns around and continues running at the same speed. Whenever Manoj meets Ashu, he turns around and continues running at the same speed. When Ashu comes back at *A* for the first time, how far (in meters) is Manoj from *B*?
(A) 360 (B) 435 (C) 510 (D) 200

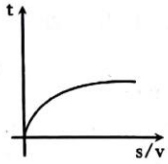
Q.65 A function H is defined for all positive integers that satisfy the following condition :
$H(1) + H(2) + ... + H(x) = x^2H(x)$. If
$H(1) = 2006$, then find the value of $H(2005)$
(A) 2/2005 (B) 2/2006!
(C) 2/2006! (D) 2/2005!

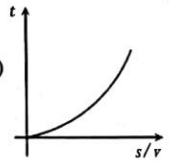
PHYSICS

Q.66 A body is moved from rest along a straight line by a machine delivering constant power. The ratio of the displacement and velocity (s/v) varies with time t as

(A) 

(B) 

(C) 

(D) 

Q.67 A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half-submerged in a liquid of density ρ at equilibrium position. When the cylinder is given a small downward push and released it starts oscillating vertically with a small amplitude. If the force constant of the spring is k, the frequency of oscillation of the cylinder is :

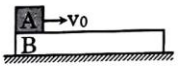
(A) $\frac{1}{2\pi}\left(\frac{k-A\rho g}{M}\right)^{1/2}$ (B) $\frac{1}{2\pi}\left(\frac{k+A\rho g}{M}\right)^{1/2}$

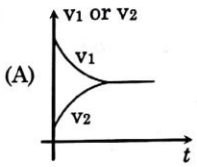
(C) $\frac{1}{2\pi}\left(\frac{k+\rho gL^2}{M}\right)^{1/2}$ (D) $\frac{1}{2\pi}\left(\frac{k+A\rho g}{A\rho g}\right)^{1/2}$

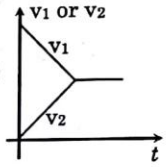
Q.68 Equations of a stationary and a travelling waves are $y_1 = a \sin kx \cos \omega t$ and $y_2 = a \sin(\omega t - kx)$. The phase difference between two points $x_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$ are ϕ_1 and ϕ_2 respectively for the two waves. The ratio $\frac{\phi_1}{\phi_2}$ is

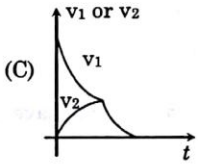
(A) 1 (B) $\frac{5}{6}$ (C) $\frac{3}{4}$ (D) $\frac{6}{7}$

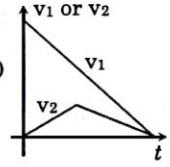
Q.69 A block A is placed over a long rough plank B of same mass as shown in figure. The plank is placed over a smooth horizontal surface. At time $t = 0$, block A is given a velocity v_0 in horizontal direction. Let v_1 and v_2 be the velocities of A and B at time t. Then choose the correct graph between v_1 or v_2 and t



(A) 

(B) 

(C) 

(D) 

Q.70 Velocity time equation of a particle moving in a straight line is $v = 2t - 4$ for $t \le 2$s and $v = 4 - 2t$ for $t > 2s$. The distance travelled by the particle in the time interval from $t = 0$ to $t = 4$s is (here, t is in second and v in m/s)

(A) 12m (B) 16m (C) 4m (D) 8m

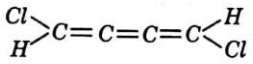
CHEMISTRY

Q.71 A 0.60 g sample consisting of only CaC_2O_4 and MgC_2O_4 is heated at 500°C, converting the two salts of $CaCO_3$ and $MgCO_3$. The sample then weighs 0.465 g. If the sample had been heated to 900°C, where the products are CaO and MgO, what would the mixtures of oxides have weighed ?

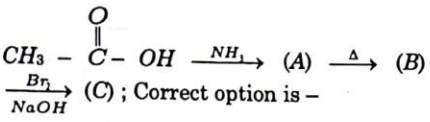
(A) 0.12 g (B) 0.21 g

(C) 0.252 g (D) 0.3 g

Q.72 Choose the correct option for the following molecule in view of chemical bonding :



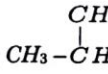
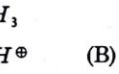
(A) non-planar
(B) $\mu \neq 0$
(C) (A) and (B) both
(D) $\mu = 0$

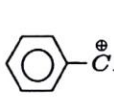
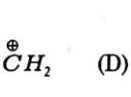
Q.73  ; Correct option is –

(A) $A = CH_3 - \overset{O}{\overset{\|}{C}} - NH_2$
(B) $B = CH_3 - C \equiv N$
(C) $C = CH_3 - NH_2$
(D) None of these

Q.74 Which of the following Ion have highest magnetic moment -
(A) Fe^{2+} (B) $Cu^{\oplus}$
(C) Mn^{2+} (D) V^{3+}

Q.75 Which Intermediate is most stable -

(A)  (B) 

(C)  (D) 

BIOLOGY

Q.76 Which one of the following four glands is correctly matched with the accompanying description
(A) Thyroid - Hyperactivity in Young children causes cretinism
(B) Thymus - Starts undergoing atrophy after puberty
(C) Parathyroid - Secretes parathormone that promotes movement of calcium ions from blood into bones during calcification
(D) Pancreas - Delta cells of the Islets of Langerhans secret a hormone that stimulates glycolysis in liver

Q.77 In mammals, the autonomic system is composed of
(A) Sympathetic and parasympathetic nerves
(B) Cranial and spinal nerves
(C) Brain and spinal cord
(D) Medullated and nonmedullated nerves

Q.78 If Henle's loop were absent from mammalian nephron, which of the following is to be expected
(A) There will be no urine formation
(B) There will be hardly any change in the quality and quantity of urine formed
(C) The urine will be more concentrated
(D) The urine will be more dilute

Q.79 During circulation, blood passes from the inferior vena cava into the diastolic atrium of the heart because of
(A) Pushing of venous values
(B) A differential pressure between the atrium and the vena cava
(C) The beating of the sinoatrial node
(D) Gravitational pull

Q.80 Which one of the following is the correct matching of the site of action of the given substrate, the enzyme action upon it and the end product ?
(A) Small intestine :
proteins $\xrightarrow{\text{Pepsin}}$ amino acids
(B) Stomach : fats $\xrightarrow{\text{Lipase}}$ micelles
(C) Duodenum triglycerides $\xrightarrow{\text{Trypsin}}$ monoglycerides
(D) Small intestine :
starch $\xrightarrow{\alpha\text{ Amylase}}$ disaccharide (maltose)

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-1

Hints & Solutions

Answer Key

1.(A)	2.(A)	3.(D)	4.(A)	5.(D)	6.(B)	7.(B)	8.(D)	9.(A)	10.(B)	11.(C)	12.(A)	13.(B)	14.(B)
15.(B)	16.(A)	17.(B)	18.(A)	19.(A)	20.(B)	21.(C)	22.(A)	23.(C)	24.(C)	25.(B)	26.(C)	27.(B)	28.(B)
29.(A)	30.(B)	31.(D)	32.(B)	33.(D)	34.(D)	35.(C)	36.(D)	37.(D)	38.(A)	39.(B)	40.(A)	41.(B)	42.(D)
43.(D)	44.(C)	45.(B)	46.(D)	47.(B)	48.(A)	49.(A)	50.(C)	51.(A)	52.(A)	53.(C)	54.(C)	55.(B)	56.(D)
57.(B)	58.(C)	59.(B)	60.(A)	61.(C)	62.(A)	63.(A)	64.(C)	65.(B)	66.(C)	67.(C)	68.(A)	69.(C)	70.(B)
71.(C)	72.(D)	73.(B)	74.(B)	75.(D)	76.(B)	77.(A)	78.(A)	79.(D)	80.(C)				

PART-I [One Marks Questions]

MATHEMATICS

1.[A] $T_1 = 5,\ T_2 = 10$

$T_k - T_{k-1} = (2k+1)$

$T_2 - T_1 = 5$

$T_3 - T_2 = 7$

$T_4 - T_3 = 9$

$T_n - T_{n-1} = (2n+1)$

$T_n - T_1 = 5 + 7 + 9 + \ldots\ldots + (2n+1)$

$T_n = 1 + 1 + 3 + 5 + 7 + \ldots\ldots + (2n+1)$

$= 1 + (n+1)^2$

$$\sum_{r=1}^{20} T_n = 20 + 2^2 + 3^2 + 4^2 + \ldots\ldots 21^2$$

$$= 20 + \frac{21.22.43}{6} - 1 = 3330$$

2.[A] $xy + x + y + 1 = 24 \Rightarrow (x+1)(y+1) = 24$ ...(i)

$xz + z + x + 1 = 42 \Rightarrow (x+1)(z+1) = 42$ ...(ii)

$yz + y + z + 1 = 28 \Rightarrow (y+1)(z+1) = 28$ ...(iii)

$(x+1)^2 (y+1)^2 (z+1)^2 = 24 \cdot 42 \cdot 28$

$(x+1)(y+1)(z+1) = 7 \cdot 6 \cdot 4$ ...(iv)

$z + 1 = 7$

$y + 1 = 4$

$x + 1 = 6$

$x = 5,\ y = 3,\ z = 6$

3.[D] $$T_r = \frac{3r+4}{4^r . r.(r+1)}$$

$$T_r = \frac{1}{4^{r-1}.r} - \frac{1}{4^r.(r+1)}$$

$T_1 + T_2 + T_3 + \ldots.$

$$= \left(\frac{1}{1} - \frac{1}{4.2} + \frac{1}{4.2} - \frac{1}{4^2 3} + \ldots.\right) = 1$$

4.[A] Adding given equations

$(x-1)^2 + (y-1)^2 + (z-1)^2 = 0 \Rightarrow x = y = z = 1$

5.[D] $3.3^{32} = 3(10-1)^{16} = 3[100\ I - {}^{16}C_{15}.10 + 1]$

$= 3\ (100\ I - 160 + 1)$

$= 3\ (100\ I^1 + 41)$

$= 300\ I^1 + 123 = 75\ I^{11} + 48$

6.[B] a, b are factors of the form $2^{a_1}5^{b_1}11^{c_1}$, $2^{a_2}5^{b_2}11^{c_2}$, where a_1, b_1, c_1, a_2, b_2, c_2 are non negative integers.

Since LCM of a, b is $2^3\,5^7\,11^{13}$, max $\{a_1, a_2\} = 3$, max $\{b_1, b_2\} = 7$ and max $\{c_1, c_2\} = 13$.

Hence (a_1, a_2) can be (0, 3), (1, 3), (2, 3), (3, 3), (3, 2), (3, 1), (3, 0) (one of the number is 3 and other number can be any where from 0 to 3) giving us 7 choices. Similarly (b_1, b_2) has 15 choices and (c_1, c_2) has 27 choices.

Hence total number of choices

$$= 7 \times 15 \times 27 = 2835.$$

7.[B] $x^3 + ax^2 + bx + c = (x^2 + 1)(x + a) + (b - 1)x + (c - a)$

$\Rightarrow$ since $x^2 + 1$ is a factor of the given polynomial

$\Rightarrow c = a$ & $b = 1$ there are 10 possible polynomials

8.[D] $(\sin 2x + \cos 2x)^{(\sin 2x + \cos 2x)^2} = 2$

$t^{t^2} = 2$

$\sin 2x + \cos 2x = \pm\sqrt{2}$

$$\sin\left(2x + \frac{\pi}{4}\right) = \pm 1$$

$$2x + \frac{\pi}{4} = (2x + 1)\frac{\pi}{2}$$

$$x = (4x + 1)\frac{\pi}{8}$$

9.[A] Let total work be 1 unit.

time taken by A to fill half of the tank

$$= \frac{n}{4} = \frac{1}{2},\ n = 2 \text{ hours}$$

now when the tank is half filled, C is also opened.

Time taken to remove (1/4)th of the tank,

$$\frac{k}{3} - \frac{k}{4} = \frac{1}{4},\ k = 3 \text{ hours}$$

$$\text{now remaining work} = 1 - \frac{1}{4} = \frac{3}{4}$$

time taken to complete the work from here on,

$$\frac{r}{4} + \frac{r}{5} - \frac{r}{3} = \frac{3}{4},\ r = \frac{45}{7}$$

total time from $t = 0$,

$$= n + k + r = 2 + 3 + \frac{45}{7} = \frac{80}{7} \text{ hours}$$

10.[B] Let track length be $12kt$ & there speeds be $5k$, k & k

time at which A meets $C = 2t, 4t, 6t, 8t, 10t$ & so on time at which A meets $B = 3t, 6t, 9t$ & so on....

so, in every 6 units of time, A meets C 3 time & B two times,

in $36t$ cards distributed to $C = 6 \times 3 = 18$

& that to $B = 6 \times 2 = 12$

remaining cards = 3

in next $4t$ time, C gets 2 & B gets 1

diff = 20 – 13 = 7

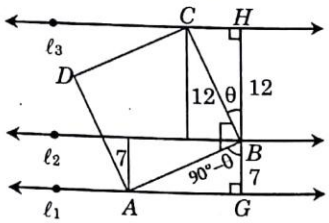
11.[C] Sum of the angles of the seven triangles $= 180° \times 7 = 1260°$

The base angles of the triangle are the exterior angles of the seven-sided polygon.

Now their sum $= 2 \times 360° = 720°$

$\therefore$ the sum of the angles at the vertices marked $= 1260° - 720° = 540°$

12.[A] Let a be the side of square;



In triangle CHB

$$\cos\theta = \frac{12}{a}$$

In triangle ABG

$$\cos(90 - \theta) = \frac{7}{a} \quad \Rightarrow \sin\theta = \frac{7}{a}$$

$$\sin^2\theta + \cos^2\theta = 1$$

$$\frac{144}{a^2} + \frac{49}{a^2} = 1 \quad \Rightarrow a^2 = 193$$

13.[B] $2\log(x-y) = \log x + \log y$

$(x-y)^2 = xy$

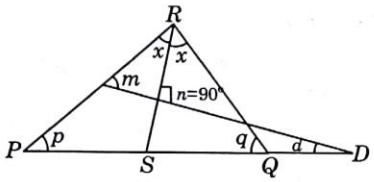
$x^2 + y^2 - 3xy = 0$

$\left(\frac{x}{y}\right)^2 - \frac{3x}{y} + 1 = 0$ (divide by y^2)

$\therefore \frac{x}{y} = \frac{3 \pm \sqrt{9-4}}{2} = \frac{3 \pm \sqrt{5}}{2}$

Since $x > y \quad \therefore \frac{x}{y} > 1 \quad \therefore \frac{x}{y} = \frac{3+\sqrt{5}}{2}$

14.[B]



$x + m = n = 90°$

In ΔPSR

$\angle RSQ = x + p$

In ΔRSQ

$x + x + p + q = 180°$

$2x + p + q = 180°$

$2(90° - m) + p + q = 180°$

$180° - 2m + p + q = 180°$

$2m = p + q$

$m = \frac{p+q}{2}$

15.[B] Split the digits into pairs viz :

(0, 1), (1, 2),..... (8, 9)

Disjoint pairs out of these are

(0, 1), (2, 3), (4, 5), (6, 7), (8, 9)

(there is no other set of 5 disjoints pairs)

Now two cases are

(a) when the pair (0, 1) is not used for first and the last place.

The number of ways = $4 \times 4! \times 2^5$

(b) when the pair (0, 1) is used for first and last place.

The number of ways = $1 \times 4! \times 2^4$

$\therefore$ Total number of ways = $9 \times 4! \times 2^4$

$= 3456$

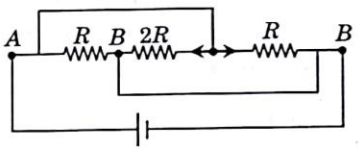
PHYSICS

16.[A] $v_2 = 2v_1$

$(1+e)\,u_1 = 2(1-e)u_1$

$e = \frac{1}{3}$

17.[B]



In figure all resistance are connected in parallel.

So $R_{eq} = \frac{2R \times R/2}{2R + R/2}$ and current in all resistance flow from positive terminal of battery (means A end) to negative terminal of battery (means B end).

18.[A] As $\frac{5\lambda}{2} = 20 \Rightarrow \lambda = 8$ cm

$K = \frac{2\pi}{\lambda} = \frac{314}{4}$

$\omega = KV = \frac{2\pi}{8\times10^{-2}} \times 350 = 27475$

$\therefore y = 0.05 \sin\left(\frac{314}{4}x - 27475t\right)$

19.[A] Let A & B are two points on an isothermal curve. Join A & B by any curve C. Then on this curve c,

$\Delta U = 0$, where c is not an isothermal curve.

20.[B] First maxima after O will appear when path difference $\Delta S = \lambda$

so $AP - BP = \lambda$

$\sqrt{2.4^2 + 1^2} - 2.4 = \lambda \quad \Rightarrow \lambda = 0.2$

sound velocity = $n\lambda = 1800 \times 0.2 = 360$ m/s

21.[C] $t_{(OS)} = 1$ sec ; $t_{(OT)} = 3$

or $t_{(ST)} = t_{(OT)} - t_{(OS)} = 3 - 1 = 2$ sec

$\therefore \quad t_{(SM)} = \frac{1}{2} t_{(ST)} = 1$ sec

$\therefore \quad t_{(OM)} = t_{(OS)} + t_{(SM)} = 1 + 1 = 2$ sec

$\therefore$ Time of flight = $2 \times 2 = 4$ sec

22.[A] It can be seen from the diagram that only the sphere B and sphere C repel. Hence they both must be of same type. According to the fact that at least two spheres are positively charged, therefore both spheres should be positively charged. Since attraction occurs for two remaining pairs it can be concluded that the sphere A is negatively charged.

23.[C] $\alpha < \beta$ if $A > B$

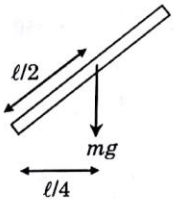
24.[C] 2.0 kg

25.[B] Weight of an object is the gravitational force exerted on the object.

For object close to surface of earth, it is approximately equal to gravitational force on the object by the earth.

26.[C] Work done by kinetic friction on a body is may be +ve, –ve or zero.

27.[B] At the instant string is cut :



$$mg.\frac{\ell}{4} = \frac{m\ell^2}{3}.\alpha$$

$$\Rightarrow \alpha = \frac{3g}{4\ell}$$

28.[B] Released energy $= 140 \times 7 + 8 \times 40 - 180 \times 6$

$= 980 + 320 - 1080$

$= 220$ MeV

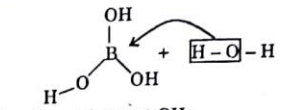
29.[A] Speed is defined as magnitude of velocity.

30.[B] $v^2 = \frac{4}{r}$

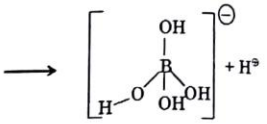
$$m^2v^2 = \frac{4m^2}{r} \quad \therefore p = \frac{2m}{\sqrt{r}}$$

CHEMISTRY

31.[D] H_3BO_3 is weak, Lewis monobasic acid



Lewise acid accept OH^- to release H^+ Ion in solution



32.[B] $\Delta U = q + w$

$= 10 \times 1000 - 2 \times (20) \times 101.3$

$= 5948$ J

33.[D] $\frac{r_X}{r_Y} = \frac{1}{5}$, ...(i)

$\frac{r_Y}{r_Z} = \frac{1}{6}$ ...(ii)

equation $(i) \times (ii)$

$\frac{r_X}{r_Z} = \frac{1}{30}$ OR $\frac{r_Z}{r_X} = 30$

34.[D] Non-metal generally disproportionate in basic medium

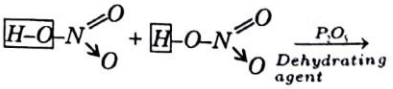
$P_4 \xrightarrow{OH^\ominus} PH_3 + H_3PO_2$

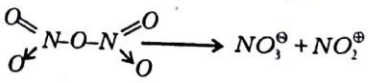
$S \xrightarrow{OH^\ominus} H_2S + SO_4^{2-}$

$Cl_2 \xrightarrow{OH^\ominus} ClO^\ominus + Cl^\ominus$

$\xrightarrow{OH^\ominus} ClO_3^\ominus + Cl^\ominus$

A Element in it's Intermediate O.S. can undergo disproportionation

35.[C] 



36.[D] $\pi = i\,C\,R\,T$

For Isotonic solution at same temperature $i\,C$ must be same

(A) $\begin{matrix}1\times0.1\,Urea\\2\times0.1\,NaCl\end{matrix}$ (B) $\begin{matrix}1\times0.1\,Urea\\3\times0.2\,MgCl_2\end{matrix}$

(C) $\begin{matrix}2\times0.1\,NaCl\\3\times0.1\,Na_2SO_4\end{matrix}$ (D) $\begin{matrix}3\times0.1\,Ca(NO_3)_2\\3\times0.1\,Na_2SO_4\end{matrix}$

37.[D] $\Delta T_b \propto i$

$F.P \propto \frac{1}{i}$

For glucose $i = 1$

38.[A] Due to more ionic character of Cs_2CO_3. Thermal stability of polyvalent anion $\propto$ ionic character

39.[B] $Al_4C_3 + H\text{–}O\text{–}H \longrightarrow 4Al(OH)_3 + 3CH_4$

40.[A] $\left.\begin{matrix}Acetylene\\Propyne\\Butyne\end{matrix}\right\} \rightarrow \begin{matrix}Br_2/Test\\Tollen's reagent Test\end{matrix}$

Although Benzene is unsaturated compound but it do not show addition reaction.

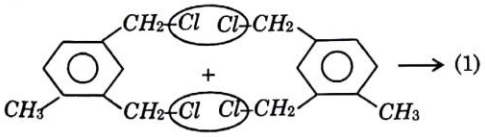
41.[B] On heating $N_2O_4 \rightleftharpoons 2NO_2$ if NO_2 is formed more, it means $\Delta H = +ve$ because endothermic are favoured with increase in temperature.

42.[D] No. of moles of O_2 required to supplied 30 kJ heat to second reaction

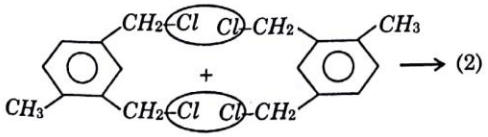
$$= \frac{30}{1260} \times \frac{3}{2} = \frac{1}{28}$$

So $n_{O_2} : n_{H_2}$ = 1/28: 3 or 1 : 84

43.[D]



(1)



(2)

44.[C] In presence of sunlight, Cl_2 undergoes free radical addition on benzene rather electrophilic substitution. Gammexene or Lindane or *B.H.C.* is formed which used as Insecticides.

45.[B] Potassium forms super oxide which is paramagnetic in nature

BIOLOGY

46.[D] Peptidoglycan

47.[B] S-phase

48.[A] Soil → Root hair cell wall → Cortex → Endomermis → Pericycle → Protoxylem → Metaxylem

49.[A] Respiration activity of root

50.[C] a-ii, b-iii, c-iv, d-i

51.[A] Inhale oxygen released by green plants

52.[A] IBA

53.[C] The epithelial cells are covered with a mucus secretion

54.[C] Nostrils → Pharynx → Larynx → Trachea → Bronchi → Bronchioles → Alveoli

55.[B] Pleura are double convering of kidney

56.[D] Lubb – Sharp closure of AV valves at the beginning of ventricular systole

57.[B] Bicuspid and tricuspid valve

58.[C] Efferent arteriole is narrower than afferent arteriole

59.[B] Blood

60.[A] Hormones produced in one species usually perform same function in other species

PART-II [Two Marks Questions]

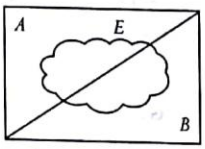
MATHEMATICS

61.[C] As $A = B = C$

$A + C = 2B$

62.[A] Clear from the diagram

63.[A]



$$P\left(\frac{E_2}{E_1}\right) = \frac{P(E_1 \cap E_2)}{P(E_1)}$$

$$\frac{1}{2} = \frac{P(E_1 \cap E_2)}{1/4}$$

$$\Rightarrow P(E_1 \cap E_2) = \frac{1}{8}$$

$$= P(E_2).P(E_1/E_2) = P(E_2) = \frac{1}{4}$$

$$\Rightarrow P(E_2) = \frac{1}{2}$$

Since $P(E_1 \cap E_2) = \frac{1}{8} = P(E_1).P(E_2)$

$\Rightarrow$ events are independent

Also $P(E_1 \cup E_2) = \frac{1}{2} + \frac{1}{4} - \frac{1}{8} = \frac{5}{8}$

$\Rightarrow E_1$ & E_2 are non exhaustive

64.[C] a, b, c are in A.P. $\Rightarrow b$ is the A.M. between a and $c \Rightarrow b = \frac{a+c}{2}$

a, mb, c are in G.P. $\Rightarrow mb$ is the G.M. between a and $c \Rightarrow m^2b^2 = ac$

$$\therefore \quad m^2b = \frac{(mb)^2}{b} = \frac{ac}{(a+c)/2} = \frac{2ac}{a+c}$$

$\Rightarrow$ m^2b = the harmonic mean between a and c.

65.[B] $E = \sin^2 x + \text{cosec}^2 x + 2 + \cos^2 x + \sec^2 x + 2$

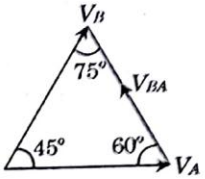
$= 5 + (\text{cosec}^2 x + \sec^2 x)$

$$= 5 + \left(\frac{1}{\cos^2 x} + \frac{1}{\sin^2 x}\right) = 5 + 4\,\text{cosec}^2\,2x$$

$E_{min} = 5 + 4 = 9$ $\quad [\because \text{cosec}^2\,2x \geq 1]$

PHYSICS

66.[C]



V_A = velocity of plane A

V_B = velocity of plane B

V_{BA} = velocity of plane B appear to passenger in A

From sine rule

$$\frac{V_A}{\sin 75^\circ} = \frac{V_B}{\sin 60^\circ} = \frac{V_{BA}}{\sin 45^\circ}$$

$$V_B = \frac{\sin 60^\circ}{\sin 75^\circ} \times 800\ kmh^{-1}$$

67.[C] Doppler's effect

$$f' = f\left[\frac{v + v_{observer}}{v - v_{source}}\right]$$

where v = velocity of sound wave

$$f' = \left[\frac{330+30}{330-30}\right] \times 1000$$

$$f' = \frac{360}{300} \times 100 = 1200\ Hz$$

68.[A] Displacement vector $= \vec{r}$

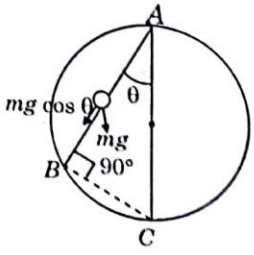
$\vec{r} = (2-3)\,\hat{i} + (1-2)\,\hat{j} + (-3-0)\,\hat{k}$

$\vec{r} = -\hat{i} - \hat{j} - 3\,\hat{k}$

$w = \vec{F}.\,\vec{r} = -6 + 3 = -3$ Joule

69.[C] Kinematics equation

$S_{AB} = \frac{1}{2}\,a_{AB}t^2$



where S_{AB} is AB and a_{AB} = acceleration of ball along AB.

Force acting on ball along $AB = mg\cos\theta$

$\therefore\ a_{AB} = \dfrac{mg\cos\theta}{m} = g\cos\theta$

From ΔABC

$\cos\theta = \dfrac{AB}{AC}$

$AB = AC\cos\theta = 2R\cos\theta$

$(2R)\cos\theta = \dfrac{1}{2}\ g\cos\theta\ t^2$

$t = \sqrt{\dfrac{4R}{g}}$

70.[B] $W = \int_{(0,0)}^{(1,1)} \vec{F}.\vec{ds}$

Here $\vec{ds} = dx\hat{i} + dy\hat{j} + dz\hat{k}$

$\vec{W} = \int (y\hat{i}+x^2\hat{j}).(dx\hat{i}+dy\hat{j}+dz\hat{k})$

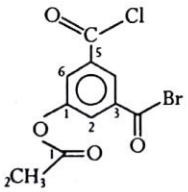
$\therefore\ W = \int_{0,0}^{1,1} (ydx + x^2dy)$

$= \int_{(0,0)}^{(1,1)} (x^2dy + x.dx)$ (as x = y)

$\therefore\ W = \left[\dfrac{y^3}{3} + \dfrac{x^2}{2}\right]_{(0,0)}^{(1,1)} = \dfrac{5}{6}\text{J}$

CHEMISTRY

71.[C]



(3-Bromocarbonyl-5-chlorocarbonyl)phenyl ethanoate

72.[D] $H_2(g)1.5$; $SO_2(g)0$; $CO_2(g)2$; $NO_2(g)0$

73.[B] ∵ concentration of A is decreasing thrice the increase in concentration of B.

Hence $3A \rightarrow B,\ n = 3$

$k_c = \dfrac{(0.2)}{(1-0.2\times3)^3} = \dfrac{0.2}{0.4\times0.4\times0.4}$

$= \dfrac{100}{32} = \dfrac{25}{8}$

74.[B] $\dfrac{r_x}{r_{He}} = \dfrac{1}{4} = \sqrt{\dfrac{4}{M_x}} \Rightarrow \dfrac{1}{16} = \dfrac{4}{M_x} \Rightarrow M_x = 64$

$z = \dfrac{PM}{dRT} \Rightarrow \dfrac{100\times64}{\frac{80}{3}\times\frac{1}{12}\times600}$

$= 4.8 > 1$(Real gas and positive deviation)

75.[D] $[Ag^+] = \dfrac{10^{-10}}{10^{-4}} = 10^{-6}$ M for AgCl ppt

$[Ag^+] = \dfrac{10^{-13}}{10^{-5}} = 10^{-8}$ M for AgBr ppt

$[Ag^+] = \dfrac{10^{-17}}{10^{-3}} = 10^{-14}$ M for AgI

BIOLOGY

76.[B] Apical dominance is removed

77.[A] Grana/thylakoids

78.[A] Ovary Glucagon Growth hormone

79.[D]

Hypothalamus	Fore brain	Controls Body temperature, urge for eating and drinking

80.[C]

Pteropus	(a)	Skin possesses hair	Mammalia

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-2

Stream – SA

Hints & Solutions

Answer Key

1.(A)	2.(C)	3.(A)	4.(D)	5.(B)	6.(C)	7.(B)	8.(A)	9.(A)	10.(A)	11.(A)	12.(B)	13.(C)	14.(B)
15.(D)	16.(D)	17.(A)	18.(A)	19.(A)	20.(C)	21.(A)	22.(C)	23.(C)	24.(D)	25.(C)	26.(B)	27.(C)	28.(B)
29.(B)	30.(D)	31.(D)	32.(B)	33.(D)	34.(B)	35.(B)	36.(B)	37.(C)	38.(C)	39.(D)	40.(D)	41.(B)	42.(D)
43.(D)	44.(D)	45.(C)	46.(B)	47.(B)	48.(C)	49.(C)	50.(B)	51.(D)	52.(D)	53.(D)	54.(C)	55.(D)	56.(A)
57.(B)	58.(C)	59.(D)	60.(D)	61.(B)	62.(B)	63.(C)	64.(A)	65.(C)	66.(A)	67.(A)	68.(D)	69.(A)	70.(A)
71.(B)	72.(D)	73.(A)	74.(A)	75.(C)	76.(D)	77.(A)	78.(B)	79.(B)	80.(D)				

PART-I [One Marks Questions]

MATHEMATICS

1.[A] In *R.H.S.* each term is positive & $e^x > 0$

So, $1 - 2x^2 \geq 0$ & $\sin x \geq 0$

$x \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$ & $x \in [2n\pi, (2n+1)\pi]$ $(n \in I)$

$\therefore x \in \left[0, \frac{1}{\sqrt{2}}\right]$

2.[C] If we put minimum no. of balls required in each box, balls left are $\frac{n(n-1)}{2}$ which can be put in n boxes in ${}^{n^2+n-2}C_{n-1}$ ways without any restriction.

3.[A] Coefficient of x^{10} in $(x^0 + x^1 \ldots\ldots x^6)^7$

= Coefficient of x^{10} in $(1 - x^6)^7 (1 - x)^{-7}$

= Coefficient of x^{10} in $(1 - 7x^6)(1 - x)^{-7}$

(Neglecting higher powers) = 6538

4.[D] *AS A.M* $\geq$ *G.M.*

$$\frac{\frac{a}{b}+\frac{b}{c}}{2} \geq \sqrt{\frac{a}{b}\cdot\frac{b}{c}} \text{ and } \frac{\frac{c}{d}+\frac{d}{e}}{2} \geq \sqrt{\frac{c}{d}\cdot\frac{d}{e}}$$

$$\therefore \left(\frac{a}{b}+\frac{b}{c}\right)\left(\frac{c}{d}+\frac{d}{e}\right) \geq 4\sqrt{\frac{a}{c}}\sqrt{\frac{c}{e}} = 4\sqrt{\frac{a}{e}}$$

$$\left(\frac{a}{b}+\frac{c}{d}\right)\left(\frac{b}{c}+\frac{d}{e}\right) \geq 4\sqrt{\frac{a}{e}}$$

Also $\frac{\frac{a}{b}+\frac{b}{c}+\frac{c}{d}+\frac{d}{e}+\frac{e}{a}}{5} \geq 5\sqrt{\frac{a}{b}\cdot\frac{b}{c}\cdot\frac{c}{d}\cdot\frac{d}{e}\cdot\frac{e}{f}} \geq 1$

$$\frac{a}{b}+\frac{b}{c}+\frac{c}{d}+\frac{d}{e}+\frac{e}{a} \geq 5$$

5.[B] Difference of any two sides of a triangle is less than third side and sum of two sides is greater than third side

$\Rightarrow AB - BC < AC < AB + BC$

$\Rightarrow 2001 - 1002 < AC < 2002 + 1001$

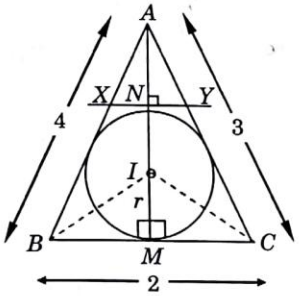
$\Rightarrow 999 < AC < 3003$

$\Rightarrow AC = 1000, 1001, 1002, \ldots, 3002$

$\therefore$ Number of possible triangles with these measurements = 2003

6.[C] Area of $\Delta ABC = \frac{1}{2} \cdot BC \cdot AM$

$= \frac{1}{2} \cdot 2 \cdot h = h$ ... (*i*)



Area of $\Delta ABC = r \cdot s$

$= r \cdot \left(\frac{2+3+4}{2}\right) = \frac{9r}{2}$ ... (*ii*)

From *Eqs.* (*i*) and (*ii*),

$h = \frac{9r}{2} \Rightarrow \frac{r}{h} = \frac{2}{9}$ ... (*iii*)

Since, $\Delta AXY \sim \Delta ABC$

$\therefore \quad \frac{XY}{BC} = \frac{AN}{AM}$

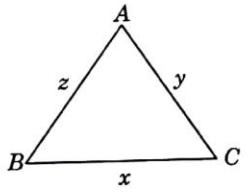
$\Rightarrow \quad \frac{XY}{2} = \frac{h-2r}{h}$

$\Rightarrow \quad XY = 2\left(1-\frac{2r}{h}\right)$ [from *Eq.*(*iii*)]

$\Rightarrow \quad XY = 2\left(1-\frac{4}{9}\right) \therefore \quad XY = \frac{10}{9}$

7.[B] Let x, y, z be the lengths of the sides such that $z = 2/s$.

$\because$ Sum of any two sides of triangle is more than third side.



$\Rightarrow x + y > z$

$\Rightarrow y > 20x$

$\therefore \quad 2004 = x + y + z > 42x$

$\Rightarrow x < \frac{2004}{42} < 48$

$\Rightarrow 2004 = x + y + z < 2(x + z) = 44x$

$\therefore \quad x > \frac{2004}{44} > 45$

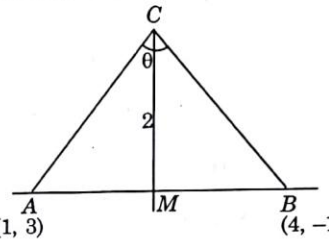
$\therefore \quad x = 46$ or 47, both of which can be verified to be solutions.

When $x = 46$, $y = 966$ and $z = 992$

When $x = 47$, $y = 987$ and $z = 970$

8.[A] Length of base $AB = 5$

$\therefore$ length of altitude $CM = 2$



Max. $\angle ACB = 2\tan^{-1}\frac{5}{4}$

$\therefore \quad \angle ACB \in \left(0, 2\tan^{-1}\frac{5}{4}\right]$

9.[A] Points satisfying to $xy > 0$, either lie in the Ist quadrant or in the third quadrant. Now point to satisfy $x + y - 1 < 0$ simultaneously. So (A) choice is correct.

10.[A] As it is given that $ab + bc + ca = 0$ so putting $x = 1$ in the equation we get

$f(1) = a(b-2c) + b(c-2a) + c(a-2b)$

$\Rightarrow f(1) = -\Sigma ab = 0$

So 1 is a root of the equation

Now product of the roots be

$1.\ \alpha = \frac{c(a-2b)}{a(b-2c)} \Rightarrow \alpha = \frac{c}{a}\left(\frac{a-2b}{b-2c}\right)$

11.[A] $AH^2 + BC^2 = 4R^2\cos^2 A + 4R\sin^2 A = 4R^2$

$\Rightarrow \frac{1}{64}(AH^2 + BC^2)(BH^2 + AC^2)(CH^2 + AB^2)$

$= \frac{64R^6}{64} = R^6 = 64$

12.[B] $P(x) = 0 \Rightarrow x = \pm\frac{1}{3}$

$\max.\left\{f(0), f\left(\frac{1}{3}\right), f(3)\right\} = 2$

Let *G.P.* is $r^2, r^3, r^4, \ldots\ldots$

so $\frac{r^2}{1-r} = 2 \Rightarrow r = \sqrt{3} - 1, -(\sqrt{3}+1)$ (rejected)

$\therefore r = \sqrt{3} - 1$

13.[C] Without any loss of generality assume the weights to be 1, 2, 3, 4, 5, 6.
It is obvious that 1 should be at the top of pyramid.
If 2, 3 make second row then

1
2 3 --------2! $\Rightarrow$ 12 ways
4 5 6 ---------3!

if 2, 4 make second row

1
2 4 --------2 $\Rightarrow$ 4 ways
3 5 6 ---------2

Total number of ways = 16

14.[B] $3(x^2+y^2+z^2+w^2)-2(xy+yz+zx+zw+wx+wy)$

$\Rightarrow (x-y)^2+(x-z)^2+(x-w)^2+(y-z)^2+(y-w)^2+(z-w)^2\geq 0$

$\Rightarrow 3\Sigma x^2-2\Sigma xy\geq 0$

$\Rightarrow \Sigma x^2\geq\frac{2}{3}\Sigma xy$

$\Rightarrow (x+y+z+w)^2=\Sigma x^2+2\Sigma xy\geq\frac{2}{3}\Sigma xy+2\Sigma xy$

$\Rightarrow (x+y+z+w)^2\geq\frac{8}{3}\Sigma xy$

$\Rightarrow \alpha^2\geq\frac{8}{3}\beta$

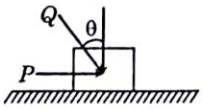
15.[D] $\because \alpha<1<\beta$ so if $f(x)=x^2-3x+\lambda$
then $f(1)<0$ So $\lambda<2$

PHYSICS

16.[D] Behaviour of disc is like a point charge because distance between the disc and the point charge is very large in comparison to radius of disc.

$$F=\frac{9\times10^9\times\frac{2}{3}\mu C\times\frac{1}{3}\mu C}{1^2}=2\ mN$$

17.[A]



$N=mg+Q\cos\theta$

$P+Q\sin\theta\leq\mu N \Rightarrow \mu\geq\frac{P+Q\sin\theta}{N}$,

$\mu\geq\frac{P+Q\sin\theta}{mg+Q\cos\theta}$

18.[A] zero

19.[A] Time period $T=2\pi\sqrt{\frac{\mu}{k}}$

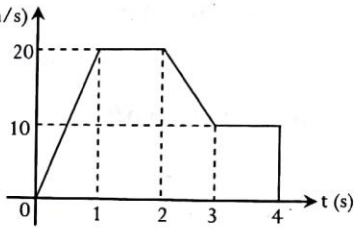
where $\mu=\frac{M_1M_2}{M_1+M_2}=\frac{M\times M}{M+M}=\frac{M}{2}$

So, time period $T=2\pi\sqrt{\frac{M}{2\alpha}}$ $(\because k=\alpha)$

20.[C] $\frac{R}{2}(T_2-T_1)$

21.[A] Buoyant force = $F_b=V_{sub}.\rho_\ell.g$
where, V_{sub}, ρ_ℓ and g all are same w.r.t. O_1 and O_2.

22.[C]

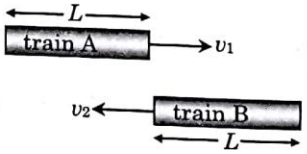


The distance travelled by the particle in 4s
= Sum of areas under V – t graph

$=\frac{1}{2}\times1\times20+1\times20+\frac{1}{2}(20+10)\times1+1\times10$

= 55 m

23.[C]



$t_1=3=\frac{2L}{v_1+v_2}\Rightarrow v_1+v_2=\frac{2L}{3}$ ...(i)

$t_2=2.5=\frac{2L}{1.5v_1+v_2}$

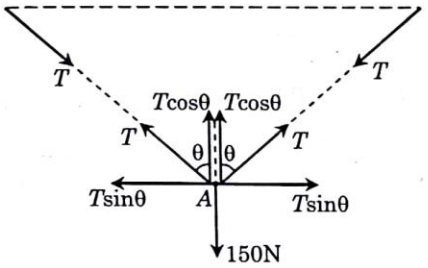
$\Rightarrow 1.5v_1+v_2=\frac{4L}{5}$ ...(ii)

by (i) and (ii)

$v_1=\frac{4L}{15}; v_2=\frac{2L}{5}$

Now, $t_3=\frac{2L}{|v_1-v_2|}=\frac{2L}{2L/15}=15$ sec

24.[D]



$T\cos\theta + T\cos\theta - 150 = 0$

[Equilibrium of point A]

$2T\cos\theta = 150 \quad ; \quad T = \frac{75}{\cos\theta}$

When string become straight θ becomes 90°

$\Rightarrow \quad T = \infty$

25.[C] The total distance moved by particle in one time period is four times the amplitude.

26.[B] $f_{fun.} = \begin{cases} \frac{v}{2\ell} & \text{for open pipe} \\ \frac{v}{2\ell} & \text{for closed pipe} \end{cases}$

$f \propto \sqrt{T}$, but f does not depend on pressure

for closed pipe $f_{1^{st}\text{ overtone}} = 3f_{\text{fundamental}}$

27.[C] Acceleration of mass at distance x

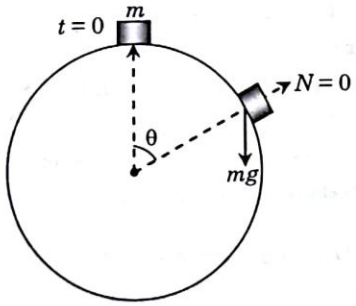
$a = g(\sin\theta - \mu_0 x\cos\theta)$

Speed is maximum, when $a = 0$

$g(\sin\theta - \mu_0 x\cos\theta) = 0$

$x = \frac{\tan\theta}{\mu_0}$

28.[B]



at loose contact $N = 0$

$mg\cos\theta = \frac{mv^2}{R}$ ...(i)

from energy conservation

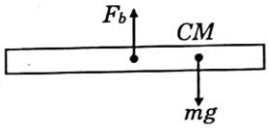
$mgR(1 - \cos\theta) = \frac{1}{2}mv^2$ ...(ii)

from (i) & (ii)

$\cos\theta = \frac{2}{3} \Rightarrow \sin\theta = \frac{\sqrt{5}}{3}$

tangential acceleration $= g\sin\theta = \frac{\sqrt{5}g}{3}$

29.[B] Torque about CM



$F_b \cdot \frac{\ell}{4} = I\alpha$

$\Rightarrow \alpha = \frac{1}{I}(\pi r^2)(\ell)(\rho)(g).\frac{\ell}{4}$

$\alpha = \frac{\pi r^2 \ell^2 g\rho}{4I}$

'α' will be same for all points on cylinder.

30.[D] having many values

CHEMISTRY

31.[D] $NO_3^- \rightarrow NO$

$N^{+5} \rightarrow N^{+2}$ change $= 3$

$N^{+5} \rightarrow 2 \times N^{+2}$ total change $= 6$

n factor of per mole $HNO_3 = \frac{6}{8} = \frac{3}{4}$

32.[B] $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$2a - x \quad 3a - x \quad 2x$

$\frac{(2x)^2}{(2a)(3a)} = 0.02 \Rightarrow \frac{x}{a} = 1.73 \times 10^{-1}$

% of I_2 reacted $= \frac{x}{3a} \times 100 = 5.77\ \%$

33.[D] $N_1V_1 + N_2V_2 + N_3V_3 = N_RV_R$

$1 \times 5 + \frac{1}{2} \times 20 + 30 \times \frac{1}{3} = N \times 1000$

$\therefore N = \frac{1}{40}$

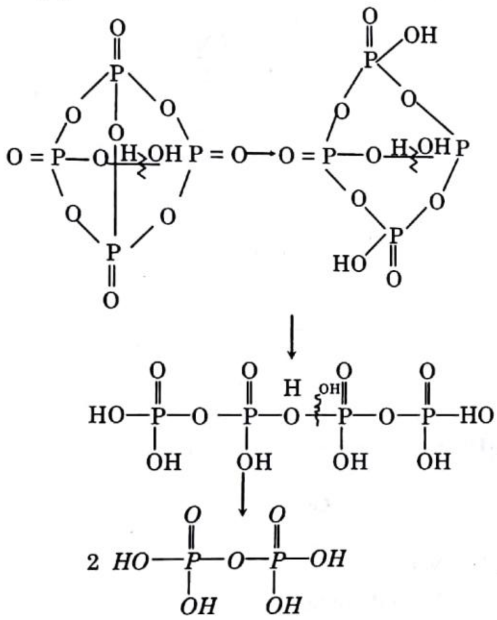
34.[B] $M \longrightarrow MCl_x$
$x\,gm \qquad y\,gm$

$$\frac{x}{E_{wt}} = \frac{y}{E_{wt}+35.5}$$

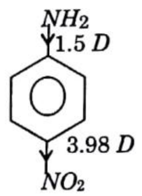
$$\frac{E_{wt}+35.5}{E_{wt}} = \frac{x}{y}$$

$$\frac{35.5}{E_{wt}} = \frac{x-y}{y} \Rightarrow E_{wt} = \frac{35.5y}{x-y}$$

35.[B]



36.[B]



Net dipole moment = 5.48 D
In this case bond moment of two dipole enhance each other

37.[C] $\lambda = \dfrac{h}{\sqrt{2mE}}$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{E_2}{E_1}} = \sqrt{\frac{9E_1}{E_1}} = 3$$

$\lambda_2 = \dfrac{1}{3}\lambda_1.$

38.[C] $-\dfrac{1}{2} \times P.E. = K.E.$

$$= -\frac{1}{2}\left[-\frac{1}{2}mkr^2\right] = \frac{1}{2}mv^2,\ mvr = \frac{nh}{2\pi}$$

$$v^2 = \frac{n^2h^2}{4\pi^2m^2r^2}\ ;\ r^4 = \frac{n^2h^2}{2\pi^2m^2k^2}$$

$r \propto \sqrt{n}$

39.[D] Heat needed to be supplied per mole
= 330 + 580 + 1820 + 2740 = 5470 kJ

no. of moles of Al taken = $\dfrac{13.5}{27}$ = 0.5 mol

$\Rightarrow$ Heat required = 0.5 × 5470 kJ = 2735 kJ

40.[D] $\Delta S = nC_v \ln\dfrac{T_2}{T_1} + nR\ln\dfrac{V_2}{V_1}$

$\Delta S = C_v \ln 2 - R\ln 2$

$\Delta S = (C_v - R)\ln 2$

41.[B] According to Avogadro hypothesis

$V \propto n$

$V = n\dfrac{(RT)}{P}$

Proportionality constant = $\dfrac{RT}{P}$

42.[D] $SrF_2\,(s) \rightleftharpoons Sr^{2+} + 2F^-$
$\qquad\qquad 2 \quad + 2s$

(where s is the solubility)

$\therefore\ 4s^3 = 32 \times 10^{-12}$

or $s = 2 \times 10^{-4}\ (M)$

But practically the solubility of $SrF_2\,(s)$ in $NaCl$ solution is slightly greater then 2×10^{-4} because $NaCl$ increases ionic strebgth of the solution.

43.[D] $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$

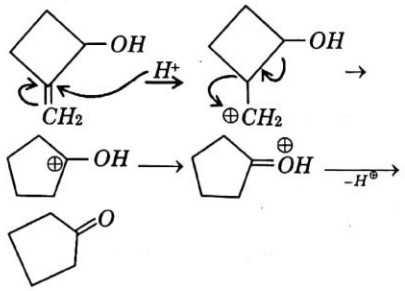
$$Kp = \frac{P_{CH_3OH}}{P_{CO} \times (P_{H_2})^2} = \frac{2}{1 \times (0.1)^2} = 200$$

Thus Kp for decomposition of CH_3OH

$$= \frac{1}{Kp} = \frac{1}{200} = 5 \times 10^{-3}\,atm^2$$

44.[D] Main function group is carboxylic acid (–COOH)

45.[C]



BIOLOGY

46.[B] Foraminiferans

47.[B] Trapa

48.[C] 26 to 35 segments

49.[C] Melanocytes

50.[B] If *A* is correct and *R* is not its explanation.

51.[D] Excessive pleural fluid in pleural cavity

52.[D] The recipient's serum should not contain the antibodies against the red blood corpuscles of the donor.

53.[D] All above

54.[C] Myoglobin and Mitochondria

55.[D] Parathyroid

56.[A] Mumps, smallpox, herpes, influenza

57.[B] Seed bearing plants

58.[C] Cytoplasm

59.[D] Connections between the adjacent cells

60.[D] 10

PART-II [Two Marks Questions]

MATHEMATICS

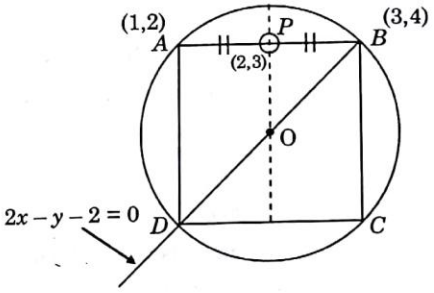
61.[B] Differentiate the given expansion w.r.t. x and put $x=-1$

$n(1-x+x^2)^{n-1}(-1+2x)$

$n(3)^{n-1}(-3)$

$-n\,3^n$

62.[B] $\because$ $OP \perp$ to given lies.



$\because$ Eq. of OP is $y-3=-1\,(x-2)$

$y-3=-x+2$

$x+y-5=0$ ...(i)

$2x-y-2=0$ ...(ii)

$3x=7 \Rightarrow x=7/3$ put in (i)

$\frac{7}{3}+y-5=0 \Rightarrow y=5-\frac{7}{3}=\frac{8}{3}$

$\therefore \left(\frac{7}{3},\frac{8}{3}\right)$

63.[C] Since the L.C.M. of the common difference of two A.P.s. is 15, therefore, we get a common term on adding 15 to the previous common term. Here, 8 is the first common term which is followed by 23, 38, 53, 68, 83, and 98.

64.[A] $4y^3-y^2x-9yx^2+\alpha x^3=0$

Let $y=mx$ is a line, then

$4m^3-m^2-9m+a=0$ ...(i)

$\therefore$ $m_1+m_2+m_3=1/4$

$m_1\,m_2\,m_3=-a/4$

But $m_1m_2=-1$

$\therefore$ $m_3=a/4$

Since m_3 is a root of (*i*)

$\therefore \quad 4\left(\frac{a}{4}\right)^3-\left(\frac{a}{4}\right)^2-9\left(\frac{a}{4}\right)+a=0$

i.e. $\frac{a^3}{16}-\frac{a^2}{16}-\frac{9a}{4}+a=0$

i.e. $\frac{a^2}{16} - \frac{a}{16} - \frac{9}{4} + 1 = 0$

i.e. $a^2 - a - 20 = 0$

$\therefore \quad a = -4, 5$

65.[C] Let the variable line be $y = mx + c$

$\therefore$ Equation the lines through the origin

$$= x^2 - (a+b) \times \left(\frac{y-mx}{c}\right) + ab\left(\frac{y-mx}{c}\right)^2 = 0$$

$\therefore c^2 + (a+b)c + ab + abm^2 = 0$

{$\because$ angle between the lines is 90°}

now foot of perpendicular to $y = mx + c$ from (0,0)

$$\frac{x-0}{m} = \frac{y-0}{-1} = -\frac{c}{1+m^2}$$

i.e. $m = -\frac{x}{y} \qquad c = y(1+m^2) = \frac{x^2+y^2}{y}$

$\therefore$ the locus is $x^2 + y^2 + (a+b)y + ab = 0$

PHYSICS

66.[A] $\vec{\tau} = \vec{M} \times \vec{B}$

$\vec{M}$ is perpendicular to plane of paper inward direction .

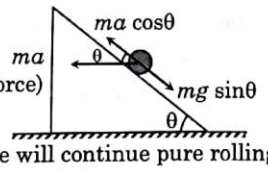
$\vec{B}$ direction is given

direction of rotation of coil and axis of rotation of obtain by $\vec{M} \times \vec{B}$

67.[A] $P = \frac{Energy}{time} = \frac{dm}{dt}gh = 100 \times 10 \times 100$

$= 100\ kW$

68.[D]



The sphere will continue pure rolling if

$mg \cos\theta = mg \sin\theta$

or $a = g \tan\theta$

69.[A] From work-energy theorem;

Work done by the all the forces = change in kinetic energy

i.e., $F.x - \mu m_1 g x - \frac{1}{2}kx^2 = 0$

But $kx = \mu m_2 g$ for just shifting m_2.

$\therefore F.x - \mu m_1 g x - \frac{1}{2}\mu m_2 g\, x = 0$

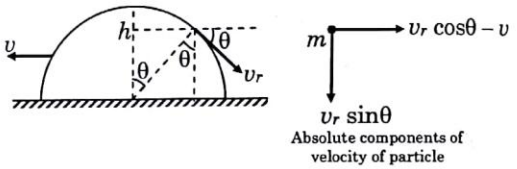
or $F = \mu\left(m_1 + \frac{m_2}{2}\right)g = 0.4\left(1 + \frac{2}{2}\right)(10)$

$= 8N$

70.[A] Let v_r be the velocity of particle relative to hemisphere and v the linear velocity of hemisphere at this moment. Then from conservation of linear momentum, we have

$P_i = P_f$

$P_i = 0,\ Pf = 4mv - m(v_r\cos\theta - v)$



$\therefore 4mv = m(v_r \cos\theta - v)$

or $5v = v_r \cos\theta$

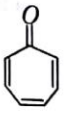
or $v_r = \frac{5v}{\cos\theta}$

$\therefore \omega = \frac{v_r}{R} = \frac{5v}{R\cos\theta}$

CHEMISTRY

71.[B] Reason hydrogen bonding. In above case Gauche form is more stable than Anti form.

72.[D]



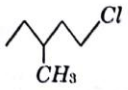
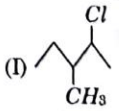
→ All carbon are sp^2 hybrid

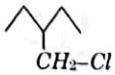
→ Cyclic delocalization of 6πe- are present

→ Cyclic planar

→ $4n + 2\pi e^-$

→ Huckle Rule

73.[A] (I)  (I) 

(III)  (II) 

74.[A] $Cl^{\ominus}$ is best leaving group due to large size leaving group ability $\propto$ stability of anion

$\propto \frac{1}{EN}$

(same period) $\propto$ size in same group (different period)

75.[C] 

Lone pair present on N atom compulsory participates in resonance with ring to complete condition for aromaticity *i.e.* so tendency to donate this electron is very very less.

BIOLOGY

76.[D] G_1 & G_2 both

77.[A] Cynobacteria

78.[B] Law of segregation

79.[B] A-iv, B-i, C-v, D-ii, E-iii

80.[D] A : perilymph, B : Tectorial membrane, C : Endolymph

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-3

Stream – SA

Hints & Solutions

Answer Key

1.(B)	2.(C)	3.(B)	4.(D)	5.(A)	6.(D)	7.(B)	8.(B)	9.(B)	10.(B)	11.(A)	12.(B)	13.(C)	14.(A)
15.(D)	16.(D)	17.(B)	18.(B)	19.(C)	20.(B)	21.(B)	22.(A)	23.(A)	24.(A)	25.(A)	26.(B)	27.(C)	28.(A)
29.(A)	30.(B)	31.(D)	32.(C)	33.(C)	34.(D)	35.(B)	36.(D)	37.(C)	38.(A)	39.(D)	40.(B)	41.(B)	42.(B)
43.(D)	44.(B)	45.(D)	46.(C)	47.(C)	48.(C)	49.(A)	50.(D)	51.(C)	52.(B)	53.(C)	54.(C)	55.(B)	56.(B)
57.(C)	58.(C)	59.(A)	60.(A)	61.(B)	62.(C)	63.(C)	64.(A)	65.(B)	66.(D)	67.(B)	68.(B)	69.(C)	70.(B)
71.(A)	72.(D)	73.(C)	74.(A)	75.(A)	76.(C)	77.(A)	78.(C)	79.(C)	80.(A)				

PART-I [One Marks Questions]

MATHEMATICS

1.[B] 3-digit numbers divisible by 7, yields 2 as remainder are 100, 107, 114, ...,996

$\therefore$ Required even numbers are

100, 114, 128, ...,996

$a = 100, d = 14, T_n = 996$

$996 = 100 + (n-1)\,14$

$n = 65$

2.[C] Required numbers are

100, 106, 112, ...,994

994 = 106, 112, ...,994

$994 = 100 + (n-1) \times 6$

$6(n-1) = 894$

$n - 1 = 149$

$n = 150$

3.[B] $(x-\alpha)^2 + y^2 = \alpha^2$

$x^2 + y^2 - 2\alpha x = 0$

since it passes through (3, 4)

$25 - 6\alpha = 0$

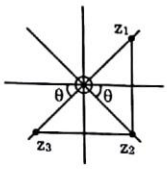
$\alpha = \frac{25}{6}$

$\therefore$ equation is $3(x^2 + y^2) - 25x = 0$

4.[D] $\arg(z_1 z_3) = \arg(z_1) + \arg(z_3)$

$= \theta + \theta + \pi$

$= 2\theta + \pi$



5.[A] $x\cos\theta + y\sin\theta = n;\ p = |\,a + \cos\theta - a\,|;$

$SP = PM \Rightarrow$ isosceles

6.[D] Given equation reduces to $Y^2 = 6X$ where

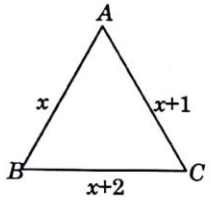
$x + 1 = X$ and $y + 2 = Y$

$\Rightarrow$ Locus is directrix

7.[B] $360 = 2^3.3^2.5$. Any odd divisor of 360 is of the form $3^a.5^b \Rightarrow S = (3^0 + 3 + 3^2)(5^0 + 5^1) = 78$

8.[B] We have, $b^2 - 4ac < 0$. *i.e.* the discriminant of $ax^2 + bx + c = 0$ is negative. So it has imaginary roots. Consequently, $y = ax^2 + bx + c$ does not cross x-axis. Hence, either $y > 0$ or $y < 0$ for all x.

9.[B] $\because\ x \in N, \quad \therefore\ A = 2C$



$$\because\ \frac{x+2}{\sin A} = \frac{x+1}{\sin B} = \frac{x}{\sin C}$$

$$\Rightarrow\ \frac{x+2}{2\sin C\cos C} = \frac{x}{\sin C}$$

$$\Rightarrow\ \frac{x+2}{2x} = \cos C$$

$$\Rightarrow\ \frac{x+2}{2x} = \frac{(x+2)^2 + (x+1)^2 - x^2}{2(x+2)(x+1)}$$

$$\Rightarrow\ (x+2)^2 = x\,[2x+1]$$

$$x^2 - 3x - 4 = 0$$

$$(x-4)(x+1) = 0 \Rightarrow x = 4$$

$\therefore$ required sides are 4, 5, 6

10.[B] Equation of the line pair through the origin and parallel to the line pair

$xy - 3y^2 + y - 2x + 10 = 0$ is $xy - 3y^2 = 0$

$\therefore$ the two line are $y = 0$

and $x - 3y = 0$ ...(i)

Equation of the lines through the origin and perpendicular to the lines (*i*) are

$x = 0$ and $3x + y = 0$

$\therefore$ the required line pair is $3x^2 + xy = 0$

11.[A] Equation of BE :

$$y = \frac{\lambda b}{\lambda a + c}x \quad \text{or} \quad k(\lambda a + c) = h\lambda b$$

$$\Rightarrow\ \lambda = \frac{kc}{bh - ka}$$

Similarly equation of CD :

$$y - 0 = \frac{\frac{\lambda b}{1+\lambda} - 0}{\frac{\lambda a}{1+\lambda} - c}(x - c)$$

$$k\left(\frac{\lambda a}{1+\lambda} - c\right) = \frac{\lambda b}{1+\lambda}(h - c)$$

$$\Rightarrow \lambda = \frac{kc}{(a-c)k + bc - bh}$$

Equating the two values of λ we get the locus of $P(h, k)$ as $2bx - (2a - c)y = bc$ which is a straight line

12.[B] $\because\ 73° + 62° = 135°$

$\because\ \tan(73° + 65°)$

$$= \frac{\tan 73° + \tan 62°}{1 - \tan 73°\tan 62°} = -1$$

$$\Rightarrow\ \tan 73° + \tan 62° - \tan 73°\tan 62° = -1$$

13.[C] Obvious

14.[A] $(BN)^2 = (AN)^2 + 100$

$h^2\cot^2 30° = h^2\cot^2 45° + 100$

$h^2(3 - 1) = 100$

$h^2 = 50 \Rightarrow h = 5\sqrt{2}\ m$

15.[D] since $\theta \in \left(-\frac{\pi}{2}, 0\right)$

$\therefore\ -1 < \sin\theta < 0$

$\therefore\ \sin\theta < \sin^3\theta < \cos\theta$ ....(i)

$\sin^3\theta < \cos\theta < \sec\theta$ ....(ii)

$\sin\theta < \sin^3\theta < \cos^2\theta$ ....(iii)

$\sin^2\theta < \sin^3\theta$

PHYSICS

16.[D] In series combination $R_{eq} = R + R$

$R_1 = R + R = 2R$

In parallel combination

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R}$$

$$R_{eq} = \frac{R}{2}$$

$$R_2 = \frac{R}{2} \Rightarrow \frac{R_1}{R_2} = \frac{4}{1}$$

17.[B] Power consumed by Heater $= \frac{V^2}{R}$

as length of filament is reduced , so R get reduced and thus power increase

$\ell_1 = \ell$

$$\ell_2 = \ell - \frac{10}{100}\ell = 0.9\ell$$

$$\frac{R_1}{R_2} = \frac{\ell_1}{\ell_2}$$

$$\frac{R_1}{R_2} = \frac{1}{0.9}$$

$$P \propto \frac{1}{R}$$

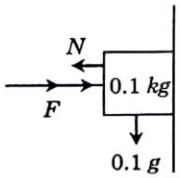
$$\therefore \frac{P_2}{P_1} = \frac{R_1}{R_2}$$

$$\frac{P_2}{P_1} = \frac{10}{0.9}$$

Percentage increase $= \left(\frac{P_2 - P_1}{P_1}\right)\times 100 =$

$$\left(\frac{P_2}{P_1} - 1\right)\times 100 = \left(\frac{10}{9} - 1\right)\times 100 = \frac{100}{9} = 11\%$$

18.[B]



No $= f = 5\ N$

$(fr)_{max} = \mu N = 0.5 \times 5 = 2.5$

Applied from $f = 0\ mg$

$= 0.1 \times 9.8 = 0.98\ N$

$\therefore Fr = 0.98\ N$

19.[C] $H = \frac{u^2 \sin^2\theta}{2g}$

where H is max height attained by projectile

For same range projection angle is θ & $90° - \theta$

$$\therefore h = \frac{u^2 \sin^2\theta}{2g} \quad \ldots (1)$$

$$h' = \frac{u^2 \sin^2(90°-\theta)}{2g} \quad \ldots (2)$$

$$\text{Range} = \frac{u^2 \sin 2\theta}{g}$$

$$R = \frac{2u^2 \sin\theta\cos\theta}{g}$$

$$R^2 = \frac{4u^4 \sin^2\theta\cos^2\theta}{g^2} \quad \ldots (3)$$

(1) multiply by (2)

$$hh' = \frac{u^4 \times \sin^2\theta\cos^2\theta}{4g^2} \quad \ldots (4)$$

From (3) & (4)

$$hh' = \frac{R^2}{16}$$

$R^2 = 16hh'$

20.[B] Using Archimedes's principle, volume of water displaced $V_{dis} = (m_{stone} + \rho_{ice}V_{ice})/\rho_{water}$. Suppose a volume of ΔV_{ice} melts, then the volume of water displaced decreases by $\rho_{ice}\Delta V_{ice}/\rho_{water}$. At the same time, since mass is conserved, the volume of water increases by $\rho_{ice}\Delta V_{ice}/\rho_{water}$. Hence there is no change in the water level. However, when all ice melts and the stone sinks to the bottom, the volume of water displaced is $m_{stone}/\rho_{stone} < m_{stone} < m_{stone}/\rho_{water}$. Hence the water level falls.

21.[B] For simple harmonic motion, $x = A\cos\omega t$ and $v = -\omega A\sin\omega t$. Substituting into the expression of the total energy,

Total energy $= kE + PE$

$$E = \frac{1}{2}av^2 + \frac{1}{2}bx^2 = \frac{1}{2}bA^2 + \frac{1}{2}(a\omega^2 - b)A\sin^2\omega t$$

E is constant during SHM as total energy is conserved.

if $\omega^2 = \frac{b}{a}$

$$E = \frac{1}{2}bA^2 + \frac{1}{2}\left(a \times \frac{b}{a} - b\right)\sin^2 \omega t A = \frac{1}{2}bA^2$$

E become independent of time and this E become constant

$$\omega = \sqrt{\frac{b}{a}}$$

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{b}{a}}$$

22.[A] Let M be the mass of the box.

If the box is not sliding,

we have $F < \mu Mg$ ... (1)

If the box tips over, it will happen at the lower right hand corner, so it is better to measure torques about this point. For tipping, clockwise moment must exceed counterclockwise moment.

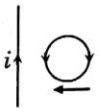
i.e. $FH > \frac{MgL}{2}$ ... (2)

Combining (1) and (2), we have (tipping before sliding)

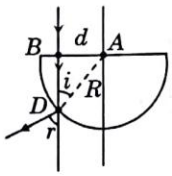
$$\frac{MgL}{2H} < F < \mu Mg$$

$$\Rightarrow \mu > \frac{L}{2H}$$

Thus, the critical condition in this case $(\mu > \mu_0)$ is $\mu_0 = \frac{1}{2H}$

23.[A] 

Induced current using lenz law in anticlockwise direction due to this current coil get repel.

24. [A] 

snell law

$\mu \sin i = 1.\ \sin r$ ... (*i*)

$\therefore$ For Total internal reflection

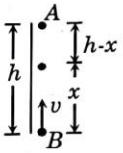
$\sin r > 1$

$\mu \sin i > 1$

from ΔABD $\sin i = \frac{AB}{AD} = \frac{d}{R}$

$$\mu \frac{d}{R} > 1$$

$$\mu > \frac{R}{d}$$

25. [A] 

V_A at time of collision $= \sqrt{2g(h-x)}$

V_B at time of collision $\Rightarrow \sqrt{\frac{g(h-x)}{\sqrt{2}}}$

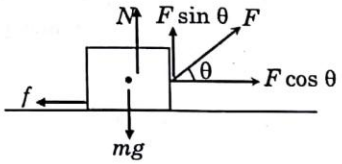
Using $V = u + at$

For A, $\sqrt{2g(h-x)} = gt$ ... (1)

For B, $\frac{1}{2}gt^2 + vt - \frac{1}{2}gt^2 = h$

$vt = h$

$$t = \frac{h}{v}$$

26.[B] 

for sliding of object $F\cos\theta$ must be greater than frictional force.

$F\cos\theta > f$

limiting value of $f = \mu N$

so $F\cos\theta > \mu N$ then only object will move

In vertical direction Net force = 0

$N - mg + F\sin\theta = 0$

$N = mg - F\sin\theta$

$F\cos\theta > \mu(mg - F\sin\theta)$

$$F > \frac{\theta mg}{\cos\theta + \theta\sin\theta}$$

F depend on $\cos\theta + \mu\sin\theta$

If $y = \cos\theta + \mu \sin\theta$ then F will be minimum when y is maximum

for maxima of y $\quad \frac{dy}{d\theta} = 0$

$-\sin\theta + \mu\cos\theta = 0$

$\tan\theta = \mu$

$\sin\theta = \frac{\theta}{\sqrt{1+\theta^2}}$

$\cos\theta = \frac{1}{\sqrt{1+\theta^2}}$

$\therefore F_{min} = \frac{\theta mg}{\frac{1}{\sqrt{1+\theta^2}} + \frac{\theta^2}{\sqrt{1+\theta^2}}} = \frac{\theta mg}{\sqrt{1+\theta^2}}$

put value of $\mu = 1$ $\quad F_{min} = \frac{mg}{\sqrt{2}}$

27.[C] Using energy conservation

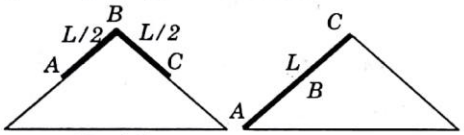


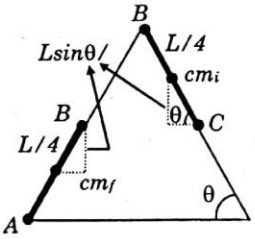
Fig. (A) *Fig. (B)*

Work energy theorem

Work done = ΔkE

Work done by gravity = $\Delta kE = kE - 0$

Both position of chain is shown in diagram AB portion of chain in fig. (A) is same as BC position in Fig. (B). Now it can be seen that BC position of Fig. (A) has come down and acquire new position in Fig. (B) as AB.



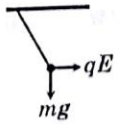
This portion BC or AB has mass = $\frac{m}{2}$

$\therefore$ work done by gravity = $\frac{mg}{2} \times S_y$

$= \frac{mg}{2} \times \left(\frac{L}{4}\sin\theta + \frac{L}{4}\sin\theta\right) = \frac{mgL\sin\theta}{4}$

$kE = \frac{mgL\sin\theta}{4}$

28.[A]



$g_{eff.} = \sqrt{g^2 + \left(\frac{qE}{m}\right)^2}$ ...(1)

$\omega_0 = \sqrt{\frac{g}{l}}$ ... (2)

$\omega = \sqrt{\frac{g_{eff.}}{l}}$ ... (3)

$\omega = 2\omega_0$ given using all equation

$E = \sqrt{15}\, mg/q.$

29.[A] Momentum conservation for A

$65 \times 2 = 60 \times v_1 + 5(v)$ ... (1)

$130 - 5v = 60v_1$

momentum $v_1 = \frac{13}{6} - \frac{v}{12}$

Momentum conservation for B

$60 \times 1 + 5\,(v) = 65 \times v_2$ ... (2)

$60 + 5\,[v] = 65v_2$

$v_2 = \frac{60}{65} + \frac{5}{65}v$

$v_2 > v_1$ for no collision

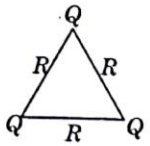
$\frac{60}{65} + \frac{5v}{65} \geq \frac{13}{6} - \frac{v}{12}$ $\quad \therefore v > 7.76$

i.e. $v = 7.8$ *m/s*

30.[B] PE of system of charge

$= \frac{kQ_1Q_2}{r_{12}} + \frac{kQ_2Q_3}{r_{23}} + \frac{kQ_3Q_1}{r_{31}}$

$Q_1 = Q_2 = Q$, $r_{12} = r_{23} = r_{31} = r$



$\therefore PE = \frac{kQ^2}{R} + \frac{kQ^2}{R} + \frac{kQ^2}{R}$

$\Rightarrow \frac{3kQ^2}{R}$

CHEMISTRY

31.[D] $K_4[\overset{+2}{Fe}(CN)_6] \rightarrow \overset{3+}{Fe} + \overset{+4}{NO_3^-}$

$-5 \quad +10\times6=+60 \quad +5$

Net change in oxidⁿ no. = + 60 + 1 = + 61

$Eq.\ wt. = \frac{M}{61}$

Oxidation of C changes from + 2 to – 2 and $O.N.$ of N changes from –3 to +5.

32.[C] $Fe_3O_4 \xrightarrow{x=2} Fe^{2+}$ (I^-, $x=1$ → I_2)

$S_2O_3^{2} \xrightarrow{x=1} S_4O_6^{2-}$ (I_2, $x=2$ → I^-)

$\therefore\ Fe_3O_4 + 2I^- \rightarrow Fe^{2+} + I_2$

$\therefore$ no. of moles of I_2 produced = 10^{-2} moles

Let v ml 0.1 (M) $Na_2S_2O_3$ solution is required

$\therefore\ v \times 10^{-4} = 2 \times 10^{-2}$

or $v = 200\ ml.$

33.[C] $P \propto n \Rightarrow \frac{n_{CH_4}}{n_{CO_2}} = \frac{3}{5}$

$\Rightarrow \frac{no.of\ atoms\ in\ container\ of\ CH_4}{no.of\ atoms\ in\ container\ of\ CO_2} = \frac{3\times5}{5\times3} = 1$

$\Rightarrow$ Both containers have equal no. of atoms

If this pressure is unequal number of moles can not be same.

34.[D] In each time we are adding 20 ml ethanol solution.

In 20 ml ethanol solution vol. C_2H_5OH = 10 ml and vol of water = 10 ml

In 10 ml ethanol mass of "X" dissolved

$= \frac{0.1}{1000} \times 10\ gm$

In 10 ml water mass of "X" dissolved

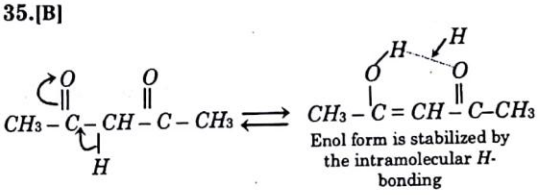
$= \frac{0.01}{1000} \times 10\ gm$

In each time, total mass of "X" dissolved

$= \frac{1.1}{1000}\ gm$

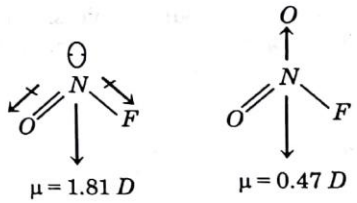
$\therefore$ No. of times of addition of ethanol solution = $\frac{11}{1.1} \times 1000 = 10^4$

35.[B]



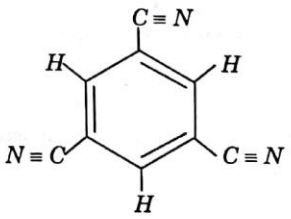
For intramolecular H bond, 5 or 6 mem. chelation is required

36.[D]



Dipole moment is vector quantity, it's value depend on geometry of molecule and direction of bond moment.

37.[C]



Total no. of π bonds = 9

Total no. σ bonds = 15

38.[A] $K.E = 13.6\ \frac{Z^2}{n^2}$ ev/atom $\Rightarrow 54.4 = 13.6 \times \frac{Z^2}{4^2}$

$\Rightarrow Z^2 = 64$

for Balmer series –

$\frac{1}{\lambda} = RZ^2\left[\frac{1}{2^2}-\frac{1}{\infty^2}\right]$ (for series limit)

$= 109678 \times 64\left[\frac{1}{4}-\frac{1}{\infty}\right]\ cm^{-1}$

$= 109678 \times 16\ cm^{-1}$

39.[D] $Sn^{4+} > Sn^{2+}$ (order of stability)

$\therefore Sn^{2+}$ act as good Reducing agent

$Sn^{2+} \rightarrow Sn^{4+} + 2e^{\ominus}$

(+2) (+4)

Also, $\left.\begin{matrix} Bi^{3+} > Bi^{5+} \\ Tl^{+} > Tl^{3+} \end{matrix}\right\}$ order of stability

(Inert pair effect)

$\therefore Bi^{5+} + 2e^{\ominus} \rightarrow Bi^{3+}$

(+5) (+3)

$Tl^{3+} + 2e^{\ominus} \rightarrow Tl^{+}$

(+3) (+1)

while in a group atomic size increases There Bi^{5+} and Ti^{3+} act as good oxidising agents

40.[B] $P_C = \frac{a}{27b^2}$, $T_C = \frac{8a}{27Rb}$

$\Rightarrow \frac{P_C}{T_C} = \frac{R}{8b} \quad \Rightarrow b = 0.04\ L/mol.$

41.[B] The dissolution of gas in liquid is an exothermic process whereas the solubility of gas increases with the increase in pressure.

$P = K_H\, n/N \quad \therefore K_H = \frac{P \times N}{n}$

Solubility of gas inversely proportional to value of K_H

42.[B] After mixing total moles of

$A^- = 100 \times 0.2 \times 10^{-3} + 100 \times 0.3 \times 10^{-3}$

$= 100 \times 10^{-3} \times 0.5$ moles

After mixing total moles of

$HA = 100 \times 0.1 \times 10^{-3} + 100 \times 0.2 \times 10^{-3}$

$= 100 \times 0.3 \times 10^{-3}$ moles

After mixing resulting $pH = 5 + \log\frac{5}{3}$

43.[D] $N_2O_5\,(g) \rightleftharpoons 2NO_2\,(g) + \frac{1}{2}O_2$

Initially : 600 torr — —

At equilibrium: $(600 - p)$torr $2p$ torr $\frac{p}{2}$ torr

Total pressure is $\left(600+\frac{3p}{2}\right)$torr

$\therefore \quad 600 + \frac{3p}{2} = 960$

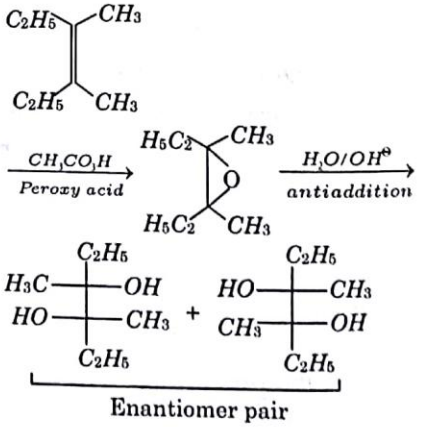
or $\frac{3p}{2} = 360$

or $p = 240$ torr

$\therefore$ fraction of $N_2O_5\,(g)$ decomposed $= \frac{240}{600}$

$= 0.4$

44.[B] In anti addition to alkene products obtained are $d(+)$ and $\ell(-)$ forms, which are enantiomers to each other.



45.[D] PE required $= mgh = 100 \times 10 \times 500$

$= 5 \times 10^5\ J$

Let W gm of glucose required

$\therefore \frac{W}{180} \times 3000 \times \frac{10^1}{4} = 5 \times 10^5$

or $\frac{W}{180} \times \frac{3}{4} \times 10^6 = 5 \times 10^5$

or $W = \frac{2}{3} \times 180 = 120\ gm$

BIOLOGY

46.[C] Photosynthesis during the day uses up some of the CO_2 produced by respiration

47.[C] Slowing down of respiration

48.[C] Diapedesis

49.[A] Decreased amount of antidiuretic hormone secretion

50.[D] *m/s*

51.[C] Aldosterone

52.[B] sieve cell

53.[C] Yucca

54.[C] 12

55.[B] H_2O

56.[B] Abscission

57.[C] All proteins are enzymes

58.[C] Contracts and flattens

59.[A] *SA* node

60.[A] Birds, reptile and insects

PART-II [Two Marks Questions]

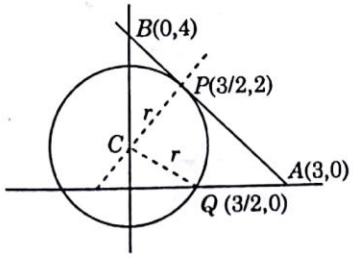
MATHEMATICS

61.[B] $f(\alpha) = (3\alpha)^3 + \frac{1}{\alpha^3}$

$$\left(3\alpha+\frac{1}{\alpha}\right)^3 - 3.3\alpha.\frac{1}{\alpha}\left(3\alpha+\frac{1}{\alpha}\right) = -10$$

62.[C] Let the centre be $C(h, k)$

$$CP \perp AB \Rightarrow \frac{2-k}{\frac{3}{2}-h} = \frac{3}{4}$$



$$6h - 8k = -7 \quad \ldots(i)$$

$$CP = CQ$$

$$\left(h-\frac{3}{2}\right)^2 + (k-2)^2 = \left(h-\frac{3}{2}\right)^2 + k^2$$

$k = 1$, Putting in equation (i), we get

$6h = 1 \Rightarrow h = 1/6$

$$\text{Radius } (r) = CQ = \sqrt{\left(\frac{1}{6}-\frac{3}{2}\right)^2 + 1}$$

$$r = \frac{5}{3}$$

63.[C] $t = 2^{11x}$

$$\frac{t^3}{4} + 4t = 2t^2 + 1$$

$t_1t_2t_3 = 4$

$2^{11(x_1+x_2+x_3)} = 2^2$

$x_1 + x_2 + x_3 = 2/11$

64.[A] $N_1 = {}^{n+3}C_3$, $N_2 = {}^{n+2}C_2$

$$\frac{N_1}{N_2} = \frac{(n+3)}{3}$$

[$\because$ n will be a multiple of 3]

as $\frac{N_1}{N_2}$ is a natural number.

$$\therefore \frac{n+3}{3} > 9 \Rightarrow n > 24$$

$\therefore$ minimum $n = 27$

65.[B] $\because T_{r+1} = {}^{296}C_r \; 5^{\frac{296-r}{3}} (3)^{r/4} x^{2r} (-1)^r$

for integral coefficient

$\frac{296-r}{3}$ & $r/4$ must be integer

(where $r \le 296$)

which is possible for

$r = 8, 20\ 32, 44 \ldots\ldots 296$

$\therefore 296 = 8 + (n-1)\ 12$

$\Rightarrow n = 25$

PHYSICS

66.[D] Lens formula

$$\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$$

$u = -1.5f$

$f = +f$

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{-1.5f}$$

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{1.5f}$$

$$v=\frac{1.5f}{0.5}=3f$$

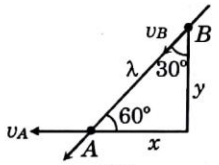
$$m=\frac{v}{u}=\frac{3f}{-1.5f}$$

$m = -2$

$| m | > 1$

$\therefore$ Image is larger as m is negative image is real.

67.[B]



$v_A \cos 60°$

Length of rod = const.

using this constraint

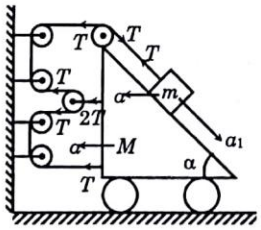
$V_A \cos 60° - V_B = 0$

$\therefore V_B = V_A \cos 60°$

Velocity of B on rod = $v_A \cos 60°$

$= 1.\frac{1}{2} = 1\ m/s$

68. [B]

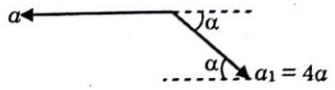


using virtual power

$T \times a + 2T \times a + T \times a - T \cos\alpha\ a + T \cos\alpha\ a - T \times a_1 = 0$

$a_1 = 4a$

a_1 = acceleration of block m with respect to wedge

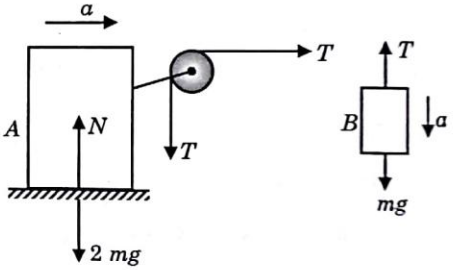


$\therefore$ acc. of m w.r.t. ground is

$= \sqrt{a^2 + (4a)^2 + 2a(4a)\cos(\pi - \alpha)}$

$= a\sqrt{(17 - 8\cos\theta)}$

69.[C] Free body diagram for block A and block B



using NLM on each block

$T = 2ma$ ...(1)

$mg - T = ma$ ...(2)

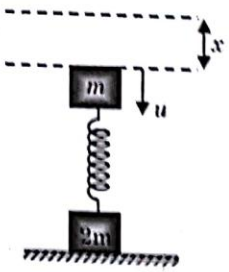
$\therefore a = \frac{g}{3}$

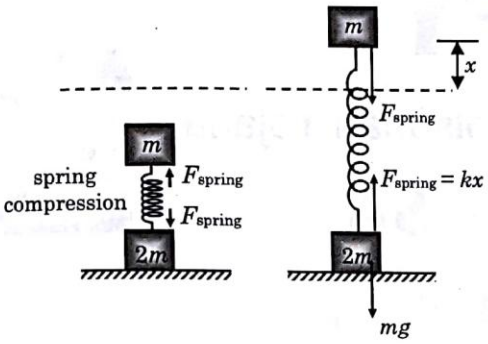
70.[B] Velocity of block A when B reach at ground $= u = \sqrt{2gh}$

To lift the block B, the elongation is x

$kx = 2\ mg$

$x = \frac{2mg}{k}$





by work energy theorem

ΔkE = work done by gravity + work done by spring

$0 - \frac{1}{2}mu^2 = -mgx - \frac{1}{2}kx^2$

or put $x = 2\ mg/k$

we get $u^2 = \frac{8mg^2}{k}$

$2gh = \frac{8mg^2}{k}$

$h = \frac{4mg}{k}$

CHEMISTRY

71.[A] $P_{gas} = 75 - \frac{101}{2} - \frac{20 \times 6.8}{13.6} \times \frac{1}{2} = 60\ cm$ of Hg

72.[D] $\Delta H = \Delta E + \Delta(PV)$

&

$\Delta E = q + W = (50 \times 300 - 3 \times 100)\ J$

[as $T_f = 2 \times 300\ K = 600\ K$]

$= 14.7\ kj$

73.[C] $Br_2(\ell) + Cl_2(g) \rightleftharpoons 2BrCl(g)$

$t = 0$	1	0	
	$(1-x)$	$2x$	

$k_p = \frac{(P_{BrCl})^2}{P_{Cl_2}} = 1$

so, $P_{Cl_2} = (P_{BrCl})^2 = 0.01$ atm

then at equilibrium, $\frac{n_{BrCl}}{n_{Cl_2}} = \frac{0.1}{0.01} = 10$

$= \frac{2x}{1-x}$

So, $10 - 10x = 2x$ or $x = \frac{10}{12} = \frac{5}{6}$ moles

Mole of $Br_2(l)$ required for maintaining vapour pressure of 0.1 atm

$= 2 \times \frac{5}{6}$ moles $= \frac{10}{6}$ moles = mole of $BrCl(g)$

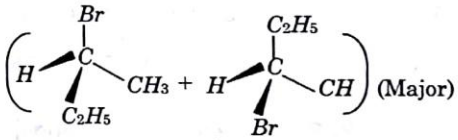
Moles required for taking part in reaction

= moles of Cl_2 used up $= \frac{5}{6}$ moles.

Hence total moles required $= \frac{5}{6} + \frac{10}{6} = \frac{15}{6}$ moles.

74.[A] $CH_3 - CH_2 - CH = CH_2$

$\xrightarrow[\text{Electrophilic addition}]{HBr} CH_3 - CH_2 - \underset{Br}{CH} - CH_3$



(Major)

$CH_3 - CH_2 - CH_2 - CH_2 - Br$ (minor)

75.[A] Benzene + $Cl_2 \xrightarrow[\text{Electrophilic substitution}]{AlCl_3}$ Chlorobenzene z.

BIOLOGY

76.[C] Carbon, hydrogen, nitrogen, oxygen and sulphur

77.[A] *DNA* content increases to double

78.[C] Homologous chromosomes pair up

79.[C] Becomes more turgid until the pressure potential of cell reaches its osmotic potential

80.[A] Inhibit the movement of electrons from *PS*-II to *PS*-I

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-4

Hints & Solutions

Answer Key

1.(B)	2.(C)	3.(B)	4.(D)	5.(A)	6.(D)	7.(B)	8.(D)	9.(A)	10.(C)	11.(C)	12.(D)	13.(B)	14.(C)
15.(A)	16.(C)	17.(A)	18.(B)	19.(B)	20.(C)	21.(C)	22.(B)	23.(C)	24.(D)	25.(A)	26.(D)	27.(A)	28.(D)
29.(B)	30.(A)	31.(A)	32.(B)	33.(D)	34.(C)	35.(D)	36.(D)	37.(B)	38.(D)	39.(C)	40.(B)	41.(C)	42.(C)
43.(B)	44.(A)	45.(C)	46.(A)	47.(C)	48.(A)	49.(A)	50.(B)	51.(A)	52.(A)	53.(A)	54.(D)	55.(A)	56.(B)
57.(A)	58.(A)	59.(B)	60.(C)	61.(C)	62.(B)	63.(A)	64.(D)	65.(B)	66.(B)	67.(A)	68.(B)	69.(A)	70.(C)
71.(B)	72.(D)	73.(A)	74.(A)	75.(A)	76.(A)	77.(D)	78.(A)	79.(B)	80.(C)				

PART-I [One Marks Questions]

MATHEMATICS

1.[B] In $\theta \in (\pi, 2\pi)$, $\operatorname{cosec}\theta \le -1$

Solving $\log_{1/3}\left(\frac{2-3x}{x}\right) \le -1$

gives $x \in \left(0, \frac{1}{3}\right]$

2. [C] $\frac{\ell n\, 43}{\ell n \cos 13^\circ} \cdot \frac{\ell n \operatorname{cosec}\theta}{\ell n \pi} \cdot \frac{\ell n \cos 13^\circ}{\ell n \operatorname{cosec}\theta} \cdot \frac{\ell n \pi}{\ell n 2}$

$= \log_2 43$

$\Rightarrow [\log_2 43] = 5$

3.[B] Where n is a non negative integer

$(2n+1)^2 = 4n^2 + 4n + 1 = 4n(n+1) + 1$

$= 8m + 1 (n(n+1)$ is even)

4.[D] Multiplying by $z - 1$, $z^6 - 1 = 0 \Rightarrow$ root with LPA is

$\cos\frac{2\pi}{6} + i\sin\frac{2\pi}{6} = \cos\frac{\pi}{3} + i\sin\frac{\pi}{3}$

5.[A] $\frac{x^2}{6} + \frac{y^2}{3} = 1;$

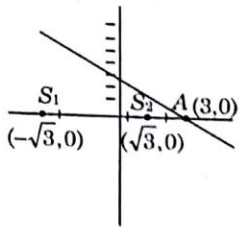
$a^2 = 6; \quad b^2 = 3 \quad \therefore e = \frac{1}{\sqrt{2}}$

$\therefore$ focus are $(\sqrt{3},0) \& (-\sqrt{3},0)$

$\because$ equation of tangent at (2, 1) is $x + y = 3$

Let A divides join of S_1, S_2 externally in the ratio

$\frac{AS_2}{AS_1} = \frac{3-\sqrt{3}}{3+\sqrt{3}} = \frac{\sqrt{3}-1}{\sqrt{3}+1}$



6.[D] It is a theorem that "if n and r are co-prime then ${}^nC_r$ will always be divisible by n".

7.[B] ${}^4C_2 \times {}^{12}C_3 \times 4\times4\times4$

Selecting Aces

Selection of 1 cards for each category cards.

8.[D] $\frac{\cos A}{a}=\frac{\cos B}{b}=\frac{\cos C}{c}$

$\Rightarrow \frac{\cos A}{k\sin A}=\frac{\cos B}{k\sin B}=\frac{\cos C}{k\sin C}$

$\Rightarrow \cot A=\cot B=\cot C$

$\Rightarrow A=B=C=60^\circ \Rightarrow \Delta ABC$ is equilateral

Hence, $\Delta=\frac{\sqrt{3}}{4}a^2=\sqrt{3}$.

9.[A] $axy+bx+cy+d=0$ represents a pair of straight lines if $\Delta=0$

$\Rightarrow a(bc-ad)=0$

$\Rightarrow bc=ad \quad [\because a\neq 0]$

Also lines cannot be parallel $[\because a\neq 0]$

10.[C] Assume $C(a, b) \Rightarrow 9a+7b+4=0$;

$3h=a+6$ & $3k=b-6$

Ans.: $27x+21y-8=0$

11.[C] $\because \frac{(1+\tan^2 x)^2-\tan^2 x}{\tan^2 x}>0$

$\Rightarrow x\in R-n\frac{\pi}{2}, n\in Z$

12.[D] $\because \cos A=\frac{3}{4}$

$\because 64\sin\frac{A}{2}\sin\frac{5A}{2}$

$=32[\cos 2A-\cos 3A]$

$=32[2\cos^2 A-1-4\cos^3 A+3\cos A]$

$=32\left[2\left(\frac{9}{16}\right)-1-4\left(\frac{27}{64}\right)+\frac{9}{4}\right]=22$.

13.[B] Given $\sec\theta+\tan\theta=1$

$\Rightarrow \sec\theta-\tan\theta=1$

$[\because \sec^2\theta-\tan^2\theta=1]$

$\therefore 2\sec\theta=2\Rightarrow\sec\theta=1$

$\therefore \cos\theta=1$

Clearly, 1 is a root of given quadratic equation

$\therefore \sec\theta$ and $\cos\theta$ are roots of given quadratic equation.

14.[C] $\log_{0.3}|z-1|>\log_{0.3}|z-1|$

i.e. $|z-1|<|z-i|$

i.e. $(x-1)^2+y^2<x^2+(y-1)^2$

where $z=x+iy$

i.e. $-2x+1<-2y+1$

i.e. $x>y$ *i.e.* $x-y>0$

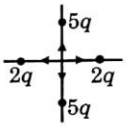
15.[A] $C\Rightarrow$ negative real axis;

$D\Rightarrow$ perpendicular bisector of the line joining

(0 , 1) & (1, 0)

PHYSICS

16.[C]



4

In Situation 4, net field is zero.

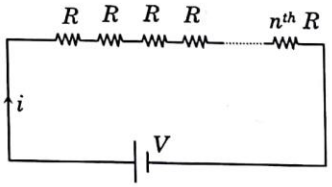
In this case, field due to left side charge is cancel out by right side and field due to above charge is cancel out by below charge.

17.[A] $P=\frac{V^2}{R}$

equivalent resistance of n light bulb

$= n\times$ Resistance of 1 bulb $= nR$

i = Current in circuit $=\frac{V}{nR}$



Total power $= i^2R_{eq}=\left(\frac{V}{nR}\right)^2\times nR$

$P_{total}=\frac{V^2}{nR}$

Power draw by each bulb $= P$

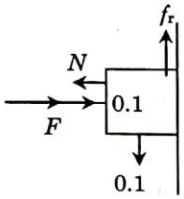
$P=i^2R$

$P=\frac{V^2}{n^2R^2}\times R=\frac{V^2}{n^2R}$

$$\frac{V^2}{nR} = nP$$

$\therefore \quad P_{total} = nP$

18.[B]



Free body diagram

$N = F = 5\ N$

limiting friction $(f_r)_{max} = \mu N = 0.5 \times 5 = 2.5$

In vertical direction block is in equilibrium

$\therefore \quad f_r = mg$

$f_r = 0.1 \times 9.8$

$f_r = 0.98\ N$

$f_r \leq f_{r\,max}$

so it is static condition

$\therefore \quad f_r = 0.98\ N$

19.[B] Lens formula put $u = -30$

$f = -20$ (diverging lens)

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} + \frac{1}{30} = -\frac{1}{20}$$

$$\frac{1}{v} = -\frac{1}{20} - \frac{1}{30}$$

$v = -12\ cm$

$$m = \frac{v}{u} = \frac{-12}{-30} = \frac{12}{30}$$

$m < 1$ and m = positive

Lens formula put $u = -30$

$f = -20$ (diverging lens)

$\therefore$ image is small

$\therefore$ image is erect

20.[C] Due to emission of 7 α particle mass number decrease by 28 and Z decrease by 14.

Due to β^{-1} particle, Z increase by 1

$\Rightarrow \therefore 92 - 14 + n \times 1 = 82$

$n = 4$

No. of β particle = 4

21.[C] Electric force on e^- is acting in y direction as E is in negative y-axis. Electric force get counter balance by magnetic force in $-y$ direction and for this magnetic field should be into the page

22.[B] $$\frac{d^2x}{dt^2} = -\alpha x$$

$$\frac{d^2x}{dt} = -\omega^2 x$$

$a = -\omega^2 x$

$\omega = \sqrt{\alpha}$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\alpha}}$$

23.[C] The correct answer is C. Think of this as a torque problem, with the sum of torques about the centre of mass adding up to zero.

$\sum \tau = 0$

$\tau_{feet} - \tau_{head} = 0$

$r \times F_{feet} = r \times F_{head}$

$x(200\ N) = (L - x)(300\ N)$

$200x + 300x = 300\ L$

$$x = \frac{3}{5}L$$

24.[D] For isolated systems, all three conservation laws are always in effect:

Total energy is conserved (although kinetic energy K is not conserved in this perfectly inelastic collision), linear momentum is conserved, and angular momentum is conserved.

25.[A] B measuring the distances and times for the ball's motion we can estimate its initial and final velocities, and by measuring the mass of the ball, we'll be able to calculate the change in momentum, which is equal to the impulse applied to the ball.

These quantities are all reasonably measured: the mass of the ball can be measured using a balance or spring scale, and the distance and time of the ball's motion can be estimated on the field, or even recorded using a camera and analyzed frame by frame.

Impulse can also be calculated using Force and time of contact, but these are very difficult to measure on the field. The

Force varies over time, and the time of contact is usually very short—much less than a second—so trying to get good measurements of these quantities is beyond the capabilities of most physics classroom labs.

26.[D] Rate of melting of ice $\propto$ rate of heat transfer and rate of heat transfer

$$= \frac{Temperature\ difference}{\frac{\ell}{KA}}$$

or rate of heat transfer

$$\propto \frac{Temperature\ difference}{\ell} A$$

If temperature difference, A and ℓ all are doubled, then obviously rate of heat transfer or rate of melting of ice will be doubled.

27.[A] Efficiency is the useful work output divided by the heat input to an engine. So, in one second, 500 J of useful work was created. At 20% efficiency, this means that every second, 2500 J of heat had to be input to the engine. Any heat not used to do work is exhausted to the environment. Thus, 2000 J are exhausted.

28.[D] Think of Man on a skateboard on this graph, he will oscillate back and forth about $x = 0$. Because he starts with a KE of 10 J, he can, at most, have a potential energy of 10 J, which corresponds on the graph to a maximum displacement of 5 cm. (The mass cannot have constant acceleration because constant acceleration only occurs for a constant force; a constant force produces an energy graph that is linear. The mass will not come to rest because we are assuming a conservative force, for which KE can be converted to and from PE freely.)

29.[B] Velocity of longitudinal wave $v_1 = \sqrt{\frac{Y}{\rho}}$

Velocity of transverse wave $v_2 = \sqrt{\frac{F}{\mu}}$

$$= \sqrt{\frac{F/A}{\rho}}$$

Since $v_1 = 30\ v_2 \Rightarrow \sqrt{\frac{Y}{\rho}} = 30\sqrt{\frac{F/A}{\rho}}$

$$\Rightarrow \left(\frac{F}{A}\right) = \frac{Y}{900}$$

30.[A] $\ell = \frac{5\lambda_1}{2} = \frac{3\lambda_2}{2}$

$$\frac{\lambda_1}{\lambda_2} = \frac{3}{5}$$

$$\lambda = \frac{V}{f}$$

$$\lambda \propto V$$

$$\lambda \propto \sqrt{M}$$

$$\sqrt{\frac{M_1}{M_2}} = \frac{3}{5}$$

$$M_2 = \frac{25}{9} \times M_1 = 25\ Kg$$

CHEMISTRY

31.[A] Let no. of moles of CH_4 present = n_1 mol.

Let no. of moles of C_2H_2 present = n_2 mol.

$\therefore$ $(n_1 + n_2) = 63\ K$...(I)

$CH_4 + 2O_2 \rightarrow CO_2\ (g) + 2H_2O\ (\ell)$

n_1 mol $\longrightarrow$ n_1 mol

$C_2H_2 + 3O_2 \longrightarrow 2CO_2\ (g) + H_2O\ (\ell)$

n_2 mol $\longrightarrow$ $2n_2$ mol.

$\therefore$ after combustion total no. of moles $= (n_1 + 2n_2) = 69\ K$ ...(II)

$\therefore$ $n_2 = 6$ Kand $n_1 = 57\ K$

$\therefore$ mole fraction of CH_4 in the original gas mix $= \frac{57K}{63K} = \frac{19}{21}$

32.[B] 118% Oleum

18 g water = 1 mole water

1 mole SO_3 = 80 g SO_3

$\therefore \quad y = 1$

$\therefore \quad n_{H_2SO_4}$ inoleum$_{(x)} = 20/98$

$$\therefore \quad \frac{x+y}{x-y} = \frac{1+\frac{20}{98}}{\frac{20}{98}-1} = -1.51$$

33.[D] $\overset{+3}{Fe_2}\overset{-2}{S_3} + 5O_2 \longrightarrow 2\overset{+2}{Fe}\overset{+6}{SO_4} + \overset{+4}{SO_2}$

$Mgm \quad 5 \times 32\ gm$

$5 \times 32\ gm\ O$ combines with $8\ M\ gm\ Fe_2S_3$

$8\ gm\ O$ combines with $\frac{M}{5\times32} \times 8 = \frac{M}{20} gm$

Fe_2S_3

$n_{factor}\ Fe_2S_3 = 20$

34.[C] Let % mole of ^{26}Mg be X

$$\frac{(21-X)25 + 26x + 79\times24}{100} = 24.31$$

$X = 10\ \%$

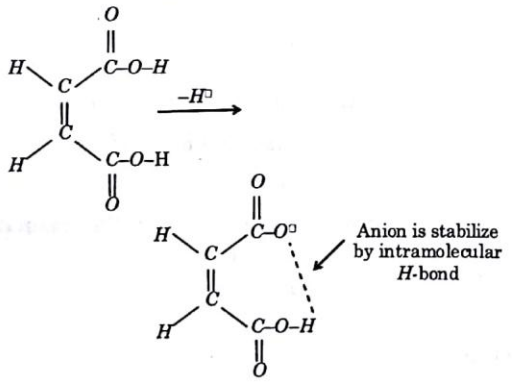
For average molecular mass

$$M = \frac{x_1M_1 + x_2M_2 + x_3M_3}{x_1 + x_2 + x_3}$$

where x_1, x_2, x_3 are mole % of Isotopes.

35.[D] Sc^{3+}, Ti^{4+} and Zn^{2+} all have zero unpaired electron Magnetic moment $= \sqrt{n(n+2)}$, n = number of unpaired e^-

36.[D] Maleic acid shows intramolecular H-bonding (chelation) and thus $-COO^{\ominus}$ is stabilized



37.[B] $K.E$ of e^- ejected = Energy of incident quantum – threshold energy = $5\ eV$

$$\lambda = \frac{h}{mV} = \frac{h}{\sqrt{2m\,K.E}}$$

$$= \frac{6.6\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times5\times1.6\times10^{-19}}}\ m$$

$$= \frac{6.6\times10^{-9}}{\sqrt{145.6}}\ m$$

38.[D] Metal is Ca = 2, 8, 8, 2

(A) CaO oxide of s-block are basic. (correct)

(B) Outermost shell contain 2 e^- hence it belong to II A group.

(C) Outermost shell is 4^{th} so belong to IV period.

(D) Wrong, because oxide is basic.

39.[C] Work done in the cyclic process = area bounded $(ABCA) = 5\ P_1V_1$

$$\frac{1}{2}\text{height} \times \text{base} = \frac{5\times2}{2} = 5P_1V_1$$

40.[B] $1\ L\ H_2(g)$ at $STP = \frac{1}{22.4}$ mol

$\therefore$ Heat released due to combustion of $\frac{1}{22.4}$ mol of $H_2(g) = 12.78\ KJ$

Heat released due to combustion of 1 mol of $H_2(g) = 12.78 \times 22.4 = 286.27\ KJ$

$\therefore$ approximate standard enthalpy of formation of $H_2O(\ell) = -286\ KJ$

41.[C] At 300 K, $\Delta G^\circ = -41.16$

$-(300 \times -4.24 \times 10^{-2}) < 0 \Rightarrow$ spontaneous

At 1200K, $\Delta G^\circ = -32.93$

$-(1200 \times (-4.24 \times 10^{-2})) > 0$

$\Rightarrow$ Non-spontaneous

42.[C] $pH = pK_a + \frac{\log[C_6H_5COO^-]}{[C_6H_5COOH]}$

$$\therefore \frac{[C_6H_5COO^-]}{[C_6H_5COOH]} = 2$$

Let volume of acid is $V\ ml$.

$$\frac{0.2\times(300-V)}{0.1\times V} = 2$$

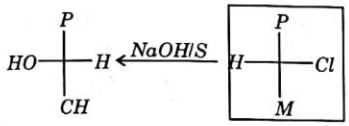
$\Rightarrow V = 200$ ml.

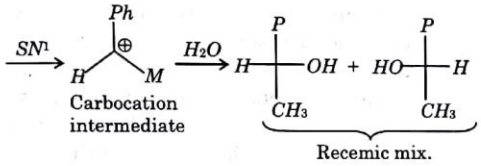
43.[B] $CH_3—CH_2—CH_2—\overset{\star}{C}H—CH_3$

$CH_3—CH(CH_3)—\overset{\star}{C}H—CH_3$

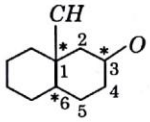
$—CH_2—\overset{\star}{C}H(CH_3)—CH_2—CH_3$

44.[A] In S_{N^2} inversion take place & In S_{N^1} racemisation take place.





45.[C]



Chiral Carbon atom is 3 with no symmetry so $2^3 = 8$ optical isom.

1	3	6
R	R	R
S	S	S
R	R	S
S	S	R
R	S	R
S	R	S
R	S	S
S	R	R

Totol 8 stereoisomers

BIOLOGY

46. [A] Plasmodium falciparum, malaria, relapse, mosquito

47.[C] Sponges have a porous body through which water flows bathing every cell

48.[A] Columnar ciliated epithelium

49.[A] Dilation of blood vessels of skin

50.[B] He will suffer from piles

51.[A] Vital capacity

52.[A] A = q, B = p, C = t, D = r

53.[A] Accumulating excess of urea in their bodies

54.[D] Peristalsis of the intestines

55.[A] Gustatoreeptor

56.[B] Capsid

57.[A] *Selaginella* and *Salvinia*

58.[A] DNA ligase

59.[B] The hydrogen bonds between the nucleotides of two strands break

60.[C] Collagen

PART-II [Two Marks Questions]

MATHEMATICS

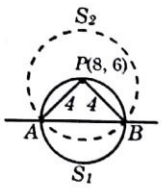
61.[C] $S_1 : x^2 + y^2 = 100$

Equation of S_2 centred at (8, 6) is

$(x-8)^2 + (y-6)^2 = 16$

$x^2 + y^2 - 16x - 12y + 84 = 0$

$\therefore$ required line AB, (*i.e* common chord)



$S_1 - S_2 = 0$

$\Rightarrow x^2 + y^2 - 16x - 12y + 84 - x^2 - y^2 + 100 = 0$

$\Rightarrow -16x - 12y + 184 = 0$

$\Rightarrow 4x + 3y - 46 = 0$

62.[B] $SP = PM = a(1 + t_1^2) = 4;$

$SQ = QM = a(1 + t_1^2) = 9.$

$SR = \sqrt{a^2(t_1t_2 - 1) + a^2(t_1 + t_2^2)}$

$= \sqrt{a(1 - t_1^2).a(1 + t_2^2)} = \sqrt{4.9} = 6$

63.[A] Given $(k-2)x^2 + 4x + 2(k-3) < 0$

$\therefore (k-2) < 0$ and $D < 0$

$k < 2 \quad 16 - 4 \times 2(k-3)(k-2) < 0$

$k \in (-\infty, 2)$ ...(1)

$16 - (k^2 - 5k + 6) < 0$

$2 - (k^2 - 5k + 6) < 0$

$k^2 - 5k + 6 - 2 > 0$

$k^2 - 5k + 4 - 2 > 0$

$k^2 - 4k - k + 4 > 0$

$k(k-4k) - 1(k-4) > 0$

$(k-4)(k-1) > 0$

$k \in (-\infty, 1) \cup (4, \infty)$ ...(2)

from equation (1) & (2) $k \in (-\infty, -1)$

64.[D] $t_n = \dfrac{(n-2)(n+1)}{n(n+3)}$

$t_3.t_4.t_5.....t_{50}$

$= \left[\dfrac{1.4}{3.6}.\dfrac{2.5}{4.7}.\dfrac{3.6}{5.8}.\dfrac{4.7}{6.9}\cdots\dfrac{(n-3)(n)}{(n-1)(n+2)}.\dfrac{(n-2)(n+1)}{n(n+3)}\right]$

$= \dfrac{1.4.2.5}{(n-1)(n+2)n(n+3)}$

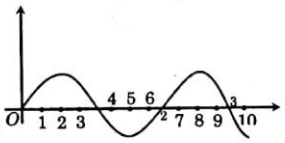
Put $n = 50$

$\dfrac{1.4.2.5}{49.52.50.53} = \dfrac{1}{7^2.5.13.53}$

65.[B] $P = \cos1°.\cos2°....\cos90°....\cos91°....\cos100° = 0$

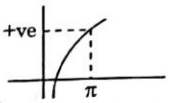
$\{\because \cos 90° = 0\}$

$Q = \sin 1 \sin 2 .....\sin 10$



By graph, it is clear that in *RHS* six terms are positive and four terms are negative, therefore, product of these ten terms is positive.

R is positive, because base that is (cosec 0.8°) is greater than 1 and number π is also greater than1.



$y = \log_{\text{cosec}\,0.8°} x$

PHYSICS

66.[B] When the container is at rest with respect to the Earth, there is pressure in the walls due to the weight of the water. The pressure results from the contact force between the water and the container. In free fall, both the water and the container have acceleration of **g**, and the contact force is zero, so removing part of a wall by making a hole produces no outward flow.(Note that some of the water is in contact with the air, which is not accelerating, so there is still atmospheric pressure on the water.)

67.[A] $\dfrac{1}{2}mv^2 = 4.t^2 \Rightarrow \dfrac{1}{2}m2v\dfrac{dv}{dt} = 4 \times 2t$

$\Rightarrow m.\dfrac{dv}{dt} = \dfrac{8t}{v} = \dfrac{8t}{\sqrt{\dfrac{8t^2}{m}}} = \sqrt{8m}$

68.[B] $P \propto \dfrac{1}{V^2} \Rightarrow P = \dfrac{k}{V^2}$

$\Rightarrow PV^2 = \kappa$

$PV.V = \kappa \Rightarrow nRTV = \kappa$

$\Rightarrow TV = \kappa_1$

Since temperature increases therefore volume decrease

69.[A] by snell's law $2\sin30° = \sqrt{13}\sin r$

$1 = \sqrt{13}\sin r$

$\sin r = \dfrac{1}{\sqrt{13}}, \tan r = \dfrac{1}{\sqrt{12}}$

So, lateral displacement $= \dfrac{t\sin(i-r)}{\cos r}$

$= \dfrac{t[\sin(i)\cos r - \cos(i)\sin r]}{\cos r}$

$= t[\sin i - \cos i \tan r]$

$$= 10[\sin 30 - \cos 30 \times \frac{1}{\sqrt{12}}]$$

$$= 10\left[\frac{1}{2} - \frac{\sqrt{3}}{2} \times \frac{1}{2\sqrt{3}}\right] = 2.5\ cm$$

70.[C] Potential drop across each bulb is E, as that in the given circuit.

CHEMISTRY

71.[B] Angular momentum $= \frac{nh}{2\pi}$

$$3.1652 \times 10^{-34} = \frac{n \times 6.626 \times 10^{-34}}{2\pi}$$

$$n = 3$$

$$\therefore \bar{v} = R \cdot Z^2 \cdot \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\bar{v} = R \cdot 2^2 \cdot \left(\frac{1}{2^2} - \frac{1}{3^2}\right) \Rightarrow \frac{5R}{9}$$

72.[D] *T, F, F*

73.[A] (B) The correct order is $BF_3 < BCl_3 < BBr_3$

(C) One mole borax will require two moles of HCl for complete reaction,

(D) The bridging hydrogens can not be methylated in B_2H_6.

74.[A] 14

75.[A] The reagent given the question has an addition "C" within bracket.

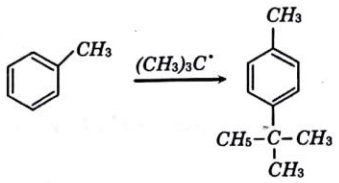
$(CH_3)_2CH–CH_2–Cl + AlCl_3 \rightarrow$

$(CH_3)_2CH–CH_2–Cl.....$

$AlCl_3 \rightarrow$

$(CH_3)_2CH–CH_2^+ + AlCl_4^-$

$(CH_3)_2CH–CH_2^+ \xrightarrow{1,2\text{-}H^- shifting} (CH_3)_3\ C^+$



BIOLOGY

76.[A] Helping growth of gut microbes that break down cellulose

77.[D] Respiration

78.[A] When arterial blood pressure exceeds blood osmotic pressure

79.[B] Bacterial metabolism inside the dung release heat

80.[C] 1 $FADH_2$, 3$NADH_2$, 1GTP

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-5

Stream – SA

Hints & Solutions

Answer Key

1.(D)	2.(D)	3.(C)	4.(A)	5.(C)	6.(A)	7.(B)	8.(D)	9.(C)	10.(D)	11.(D)	12.(C)	13.(A)	14.(A)
15.(D)	16.(C)	17.(D)	18.(C)	19.(B)	20.(C)	21.(B)	22.(B)	23.(A)	24.(A)	25.(B)	26.(B)	27.(B)	28.(A)
29.(B)	30.(C)	31.(D)	32.(C)	33.(B)	34.(B)	35.(C)	36.(D)	37.(C)	38.(D)	39.(C)	40.(B)	41.(B)	42.(B)
43.(B)	44.(B)	45.(B)	46.(B)	47.(B)	48.(A)	49.(A)	50.(A)	51.(A)	52.(B)	53.(D)	54.(D)	55.(B)	56.(B)
57.(A)	58.(B)	59.(D)	60.(C)	61.(C)	62.(C)	63.(A)	64.(A)	65.(B)	66.(A)	67.(B)	68.(A)	69.(A)	70.(D)
71.(D)	72.(C)	73.(C)	74.(C)	75.(B)	76.(C)	77.(B)	78.(D)	79.(D)	80.(A)				

PART-I [One Marks Questions]

MATHEMATICS

1.[D] $|x| - |x-3| = 3$

$(-\infty,0]$	$(0,3)$	$[3,\infty)$
$-x+x-3=3$	$x+x-3=0$	$x-x+3=3$
No solution	$x=3$	$x \in [3,\infty)$

So $x \in [3, \infty)$

Least integer =3

2.[D] Given number = $\log_{(2\sqrt{3})^2} 2\sqrt{3}$

$$= \frac{1}{2}$$

3.[C] $\because a = (-3+2)^{2n+1} = -1$

$\therefore$ equation becomes $x^2 + bx - 6 = 0$

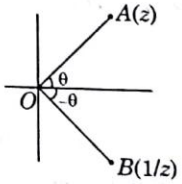
$\alpha + \beta = -b$

$\alpha\beta = -6 = -1 \times 6 = 1 \times -6$

$= -2 \times 3 = 2 \times -3$

$\therefore \quad b = \pm 5, \pm 1$

4.[A] Let complex number z representing point A and $\frac{1}{z}$ representing point B then vector $\overrightarrow{OA}$ and $\overrightarrow{OA} + \overrightarrow{OB}$ can be collinear when $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are collinear



$\Rightarrow$ z is real

If $z = \frac{i}{2}$ arg $z = \frac{\pi}{2}$

$\frac{1}{z} = -2i$

$z + \frac{1}{z} = -\frac{3}{z}i$

$\arg\left(z + \frac{1}{z}\right) = -\frac{\pi}{2}$

5.[C] $(y-3)^2 = -8(x-2)$

Equation of general tangent

$$(y-3) = m(x-2) + \frac{-2}{m}$$

$$y = mx + 3 - 2\left(m + \frac{1}{m}\right)$$

$$c = 3 - 2\left(m + \frac{1}{m}\right)$$

$$\therefore \quad m + \frac{1}{m} \in (-\infty, -2] \cup [2, \infty)$$

$$\therefore \quad 3 - 2\left(m + \frac{1}{m}\right) \in (-\infty, -1] \cup [7, \infty)$$

6.[A] Total number of divisors are 20.

$\therefore \quad 20 = 2 \times 10 = 4 \times 5 = 2 \times 2 \times 5$

$\therefore$ possible numbers are

2^{19}, $2^9 \times 3^1$, $2^4 \times 3^3$ & $2^4 \times 3^1 \times 5^1$

So least natural number is $2^4 \times 3 \times 5 = 240$.

7.[B] No. of favorable cases is equal to no. of solutions of $x + y + z = 9$

$(x, y, z) \in (0, 1, 2, \ldots\ldots, 9)$

$\Rightarrow$ No. of solutions $= {}^{11}C_2 = 55$

Total number of cases $= 1000$

$$P(A) = \frac{55}{1000} = \frac{11}{200}$$

8.[D] Let $y = \dfrac{x+2}{2x^2+3x+6}$

$2x^2y + x(3y-1) + (6y-2) = 0$

Case – I when coefficient of $x^2 = 0$ *i.e* $y = 0$

$x = -2 \; \forall \; R$

Case – II when coefficient of $x^2 \neq 0$

$\therefore \quad x$ is real

$D \geq 0$

$(3y-1)^2 - 4 \times 2y \times (6y-2) \geq 0$

$-39y^2 + 10y + 1 \geq 0$

$39y^2 - 10y - 1 \leq 0$

$(3y-1)(13y+1) \leq 0$

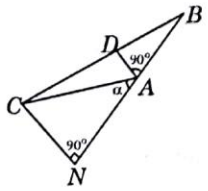
$$y \in \left[-\frac{1}{13}, \frac{1}{3}\right]$$

$$\therefore \quad \text{greatest value} = \frac{1}{3}$$

9.[C] We have $BD = DC$ and $\angle DAB = 90°$.

Draw $CN \perp$ to BA produced. Then in ΔBCN,

we have $DA = \dfrac{1}{2} CN$ and $AB = AN$.



Let $\angle CAN = \alpha$

$\tan A = \tan(\pi - \alpha)$

$= -\tan \alpha$

$$= -\frac{CN}{NA} = -2\frac{AD}{AB} = -2 \tan B$$

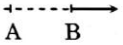
$\Rightarrow \quad \tan A + 2 \tan B = 0$

10.[D] $\because \quad AB = 5$ & $AP - BP = 5$

$\Rightarrow \quad AP - BP = AB$

$\therefore \quad AP > BP$ & A, B & P are collinear

so P can moves only on line AB but only in one direction starting from B.



$\therefore$ Locus of P is a ray.

11.[D] $\cos^7 x + \sin^4 x = 1$

$\cos^7 x \leq \cos^2 x$ and $\sin^4 x \leq \sin^2 x$

$\therefore \quad \cos^7 x + \sin^4 x \leq \cos^2 x + \sin^2 x = 1$

the equality holds only if

$\cos^7 x = \cos^2 x$

and $\sin^4 x = \sin^2 x$

i.e $\cos^2 x (1 - \cos^5 x) = 0$

and $\sin^2 x (1 - \sin^2 x) = 0$

i.e $\cos x = 0$ or $\cos x = 1$

and $\sin x = 0$ or $\cos x = 0$

$\therefore \quad \cos x = 0$ or $\cos x = 1$

i.e $x = \pm\dfrac{\pi}{2}$ and $x = 0$

$\therefore$ there are three solutions.

12.[C] Let $P = 16 \sin 144°. \sin 108°. \sin 72°. \sin 36°$

$= 16.\sin(180° - 36°). \sin(90° + 18°).$

$\sin(90° - 18°). \sin 36°$

$= 16. \sin^2 36°. \cos^2 18° = 5$

13.[A] $\sin\theta \neq \cos\theta \Rightarrow \theta \notin \left(\frac{3\pi}{2}, 2\pi\right) \cup \left(\pi, \frac{3\pi}{2}\right);$

$\theta \neq \frac{\pi}{2}, \frac{3\pi}{2}, 0, \pi, 2\pi$

and equally holds

if $\theta \in \left(\frac{\pi}{2}, \pi\right)$ or $\theta \in \left(\frac{\pi}{2}, \pi\right)$

14.[A] $|z - i\,Re(z)| = |z - lm(z)|$

Let $z = x + iy$, then

$|x + iy - ix| = |x + iy - y|$

i.e $x^2 + (y - x)^2 = (x - y)^2 + y^2$

i.e $x^2 = y^2$ *i.e* $y = \pm x$

15.[D] $(z - \bar{z})^2 + z + \bar{z} = 0$

$(2\,iy)^2 + 2x = 0$

$-4y^2 + 2x = 0$

$\Rightarrow y^2 = \frac{1}{2}x$

PHYSICS

16.[C] $\frac{1}{2}mV_m^2 = 15 \times 10^{-3}$

$V_m = \sqrt{0.150}\ m/s$

$A\omega = \sqrt{0.150}\ m/s$

$Lq_m \cdot \sqrt{\frac{g}{L}} = \sqrt{0.150}\ m/s$

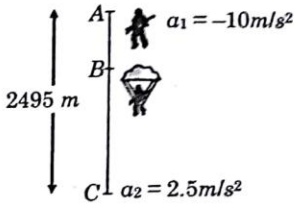
$\sqrt{gL} = \frac{\sqrt{0.150}}{100 \times 10^{-3}}$

$\Rightarrow L = \frac{0.150}{0.1} = 1.5m$

17.[D] $T - 3g = 3 \times 1$

$\Rightarrow T = 3 \times 10 + 3 = 33N$

18.[C] Suppose the man drops at A, from A to B he is falling freely & than at B parachute opens out & he falls with a retardation of $2.5\ m/s^2$.



$\therefore\ AB = \frac{1}{2} \times 10 \times 10^2 = 500m$

$\therefore\ BC = AC - AB = 2495 - 500 = 1995m$

Velocity at B,

$V_B = gt = 10 \times 10 = 100\ m/s \downarrow$

Velocity at C,

$V_C = \sqrt{V_B^2 + 2ay} = \sqrt{100^2 + 2 \times 2.5(-1995)}$

$= \sqrt{25} = 5m/s \downarrow.$

19.[B] Stable equilibrium will be when c. m. is below the point of suspension.

20.[C] (B) Initially effective resistance = $2R$. In parallel effective resistance $= \frac{R}{2}$. It has reduced by a factor of $\frac{1}{4}$ so rate of heat transfer would be increased by a factor of 4, keeping other parameters same.

21.[B] $PV = nRT$

Since both the rooms have same volume and are connected, so they will have same pressure

$PV = nRT = \text{constant}$

$\Rightarrow nT = \frac{Constant}{R} = \text{constant}$

If T is more n has to be less

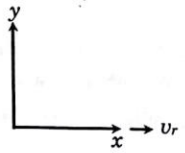
Hence, lower the temperature, more the number of molecules.

22.[B] Time taken by man to cross the river

$$= \frac{Width\ of\ river}{V_y}$$

$$12 = \frac{60}{V_y}$$

$V_y = 5$ *m/sec.*



Let the x component of velocity of man *w.r.* to river is v_x Since velocity of man *w.r.* to ground makes an angle of 45° with river flow x component of velocity of man *w.r.* to ground = y component of velocity of man *w.r.* to ground

$V_r + V_x = V_y$

$5 + V_x = 5$

$V_x = 0$

So velocity of man *w.r.* to water = V_y = 5 *m*/sec.

23.[A] $r_2 < \theta_c$; $A - r_1 < \theta_c$

$r_1 > A - \theta_c$

$\Rightarrow \sin r_1 > \sin(A - \theta_c)$

$\Rightarrow \frac{\sin i}{\mu} > \sin(A - \theta_c)$

$\Rightarrow \sin i > \mu(\sin A \cos\theta_c - \sin\theta_c \cos A)$

$= \sqrt{\frac{7}{3}}\left(\frac{\sqrt{3}}{2}\sqrt{1-\frac{3}{7}} - \sqrt{\frac{3}{7}}\cdot\frac{1}{2}\right) = 1 - \frac{1}{2} = \frac{1}{2}$

$\Rightarrow \sin i > \frac{1}{2}$

or $i > 30°$

24.[A] $\frac{1}{40} - \frac{1}{-60} = \frac{1}{f}$ 1

$\frac{1}{V} - \frac{1}{-60} = \frac{1}{2f}$ 2

$\frac{1}{V} + \frac{1}{60} = \frac{1}{2}\left(\frac{1}{40} + \frac{1}{60}\right)$

$\Rightarrow \frac{1}{V} + \frac{1}{60} = \frac{1}{2}\cdot\frac{100}{40\times60}$

$\Rightarrow -\frac{1}{V} = \frac{1}{48} - \frac{1}{60}$

$\Rightarrow V = 240cm$

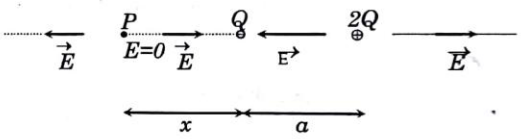
25.[B] $R = \frac{\rho\ell}{A} \Rightarrow R_1 = \frac{\rho\ell/2}{A}$

R_1 is stretched to double length but volume is constant

$A\frac{\ell}{2} = A'\times\ell \quad \therefore A' = \frac{A}{2}$

$\therefore R' = \frac{\rho\ell}{A'} = \frac{2\rho\ell}{A} = 2R$

26.[B]



$E_p = 0 = \frac{KQ}{x^2} - \frac{K2Q}{(a+x)^2} \Rightarrow a + x = \sqrt{2}x$

$\Rightarrow x = \frac{a}{\sqrt{2}-1}$

27.[B] $P = \frac{d}{dt}(mgh)$

$P_{act} = \frac{1000\times10\times100}{0.5} \Rightarrow P_{act} = 2000\ kW$

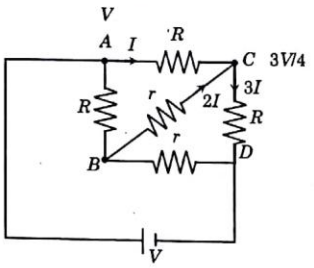
$P_{consumption} = \frac{2000}{0.25}kW = 8000kW.$

28.[A] $I_{AC} = \frac{V}{4R} = I$

$I_{CD} = \frac{3V}{4R} = 3I_{AC} = 3I$

Hence using *KCL* at junction *C*,

$I_{BC} = 3I - I = 2I = \frac{V}{2R}$.



29.[B] Mass defect

$= (238.05079 - 234.04363 - 4.00260)\ u$

$= 4.56 \times 10^{-3}\ u$

$= 4.56 \times 10^{-3} \times 1.66 \times 10^{-27} = 7.57 \times 10^{-30}\ kg$

$mc^2 = 7.57 \times 10^{-30} \times 9 \times 10^{16} = 6.8 \times 10^{-13}\ J$

30.[C] $v_{rms} = \sqrt{\frac{3RT}{M}}$

R, T and M do not change hence v_{rms} remains same.

CHEMISTRY

31.[D] $2 = \frac{mass}{63} \times \frac{1000}{250}$

$\text{Mass} = \frac{63}{2} gm$

$\text{Mass of acid} \times \frac{70}{100} = \frac{63}{2}$

$\text{Mass of acid} = 45\ gm$

32.[C] For photoelectric effect to take place,

$E_{light} \geq W \qquad \therefore \frac{hc}{\lambda} \geq \frac{hc}{\lambda_0}$ or $\lambda \leq \lambda_0$.

33.[B] At constant pressure

$PV = nRT.$

$V = \left(\frac{nR}{P}\right)T.$

So, $\log V = \log\left(\frac{nR}{P}\right) + \log T.$

$y = c + mx$

So answer is **(B)**

34.[B] For reaction

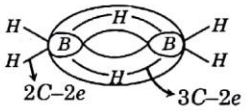
$$K_c = \frac{[O_2]^3}{[O_3]^2} = \text{constant}$$

So $$\sqrt{K_C} = \frac{[O_2]^{3/2}}{[O_3]} = \text{constant}$$

= will be same for both the containers

35.[C] The most stable oxidation state of thallium & bismuth are respectively are +1 and +3 due to inert pair effect.

36.[D]



37.[C] $NH_3 + CO_2 + H_2O \longrightarrow NH_4HCO_3$

$NaCl + NH_4HCO_3 \longrightarrow NaHCO_3 + NH_4Cl$

$2\ NaHCO_3 \xrightarrow{150°C} Na_2CO_3 + CO_2 + H_2O$

$2NH_4Cl + Ca(OH)_2 \longrightarrow 2NH_3 + H_2O + CaCl_2$

(byproduct)

38.[D] $Na_2\ [B_4O_5(OH)_4].\ 8\ H_2O$

39.[C] $n_{air} = \frac{4.92 \times 1}{24.6} = 0.2$ mol.

$no_2 = 0.2 \times 0.2 = 0.04$ mole

$nc = 0.72/12$

	C	$+\ \frac{1}{2}O_2$	$\longrightarrow$ CO
Initial mole	0.06	0.04	0
final mole	0	0.01	0.06

	CO	$+\ \frac{1}{2}O_2$	$\longrightarrow$ CO_2
Initial mole	0.06	0.01	0
final mole	0.04	0	0.02

Heat evolved $= 0.04 \times 25 + 0.02 \times 100 = 1 + 2$

$= 3$ Kcal.

40.[B] only the ionic product of CuS exceeds its K_{sp} and hence, it is precipitated only.

41.[B] $HC\equiv C-C\equiv CH$ all carbon atoms are sp hybridized.

42.[B] 

It has only six carbon atoms.

43.[B] For $C_xH_yO_zX_aN_b$ $Du = \dfrac{2x+2-y-a+b}{2}$

$\therefore$ for $C_{20}H_{24}N_2O_2$ $Du = 10 = 6db + 4$ ring

44.[B] Decolourization is due to $C=C$ bond & ozonolysis can be done on $C=C$ only.

45.[B] Negative charge on more electronegative atom is more stable

BIOLOGY

46.[B] Intestinal juice

47.[B] CO_2 concentration increases

48.[A] Artery

49.[A] Immunity

50.[A] Co-ordination of muscular movements

51.[A] Pelvis

52.[B] Thoracic ribs

53.[D] 7 cervical vertebrae

54.[D] all of these

55.[B] Glycolysis

56.[B] Cytoplasm

57.[A] Violet and Blue

58.[B] Stroma

59.[D] Potassium

60.[C] Sucrose

PART-II [Two Marks Questions]

MATHEMATICS

61.[C] Any circle which touches the line $4x + 3y = 10$ at $(1, 2)$ is $(x-1)^2 + (y-2)^2 + \lambda(4x+3y-10) = 0$

i.e $x^2 + y^2 + (4\lambda - 2)x + (3\lambda - 4)y + 5 - 10\lambda = 0$

its centre is $\left(1-2\lambda,\ 2-\dfrac{3\lambda}{2}\right)$

and radius

$$= \sqrt{(1-2\lambda)^2 + \left(2-\frac{3\lambda}{2}\right)^2 - 5 + 10\lambda} = 5$$

$$\therefore\ 1 + 4\lambda^2 - 4\lambda + 4 + \frac{9\lambda^2}{4} - 6\lambda - 5 + 10\lambda = 25$$

$$\Rightarrow\ \frac{25\lambda^2}{4} = 25 \quad \Rightarrow\ \lambda = \pm 2$$

$\therefore$ the centre are $(-3, -1)$, $(5, 5)$

62.[C] Equation of the ellipse is $\dfrac{x^2}{6} + \dfrac{y^2}{3} = 1$

$$\therefore\ e = \frac{1}{\sqrt{2}} \qquad \therefore\ ae = \sqrt{3}$$

$\therefore$ foci S' and S are $(-\sqrt{3}, 0)$ and $(\sqrt{3}, 0)$

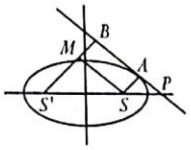
Equation of tangent at $(2, 1)$ is $2x + 2y = 6$

i.e $x + y = 3$

$\therefore$ Equation of line $S'B$ is $x - y + \sqrt{3} = 0$

$\therefore$ SM = length of $\perp$ from S on $S'B = \sqrt{6}$

$\therefore$ $AB = \sqrt{6}$



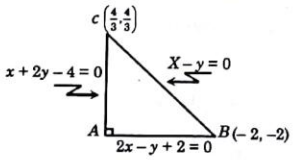
63.[A] $\dfrac{1}{3^2+1} + \dfrac{1}{4^2+2} + \dfrac{1}{5^2+3} + \dfrac{1}{6^2+4} \ldots\ldots\infty$

$$T_r = \frac{1}{(r+2)^2 + r} = \frac{1}{r^2+5r+4}$$

$$= \frac{1}{(r+1)(r+4)} = \frac{1}{3}\left(\frac{1}{r+1} - \frac{1}{r+4}\right)$$

$$S_n = \frac{1}{3}\left[\frac{1}{2}-\frac{1}{5}\right]$$
$$+\frac{1}{3}\left[\frac{1}{3}-\frac{1}{6}\right]$$
$$+\frac{1}{3}\left[\frac{1}{4}-\frac{1}{7}\right]$$
$$\vdots$$
$$+\frac{1}{3}\left[\frac{1}{n-2}-\frac{1}{n+1}\right]$$
$$+\frac{1}{3}\left[\frac{1}{n-1}-\frac{1}{n+2}\right]$$
$$+\frac{1}{3}\left[\frac{1}{n}-\frac{1}{n+3}\right]$$
$$+\frac{1}{3}\left[\frac{1}{n+1}-\frac{1}{n+4}\right]$$
$$S_n = 3\left[\frac{1}{2}+\frac{1}{3}+\frac{1}{4}-\frac{1}{n+2}-\frac{1}{n+3}-\frac{1}{n+4}\right]$$
$$S_\infty = \frac{1}{3}\left(\frac{6+4+3}{12}\right)=\frac{13}{36}$$

64.[A] $\because$ two lines represented by
$2x^2 + 3xy - 2y^2 - 6x + 8y - 8 = 0$
are $2x - y + 2 = 0$ and $x + 2y - 4 = 0$
which are perpendicular to each other.



$\therefore$ circum centre will be mid point of BC
$i.e\left(-\frac{1}{3},-\frac{1}{3}\right)$..

65.[B] $x\sin\theta = y\left(-\sin\theta\frac{1}{2}+\cos\theta\frac{\sqrt{3}}{2}\right)$

$$\Rightarrow \frac{x}{y}=\frac{\sqrt{3}}{2}\cot\theta-\frac{1}{2}$$

Similarly $\frac{x}{z}=-\frac{\sqrt{3}}{2}\cot\theta-\frac{1}{2}$

add : $\frac{x}{y}+\frac{x}{z}=-1$

$\Rightarrow xy + yz + zx = 0$

PHYSICS

66.[A] For chain to move with constant speed P needs to be equal to frictional force on the chain. As the length of chain on the rough surface increases. Hence the friction force $f_k = \mu_k N$ increases.

67.[B] The maximum kinetic energy of the electrons immediately upon ejection is the difference between the energy of the incident photon and the threshold energy.

$$K = \frac{hc}{\lambda}-\frac{hc}{\lambda_0}$$

This kinetic energy of ejected electron is converted to electrostatic potential energy, $\Delta U = eEd$, as electrons comes to rest moving in the direction of electric field. Therefore, $K = Eed$

$$\text{and } \lambda_0 = \left(\frac{1}{\lambda}-\frac{eEd}{hc}\right)^{-1}$$

68.[A] $W_F = KE \uparrow$ where $W_F = \iota\theta = (F\ell)\left(\frac{\pi}{2}\right)$

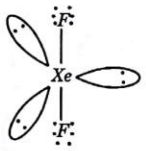
$$(F\ell)\ \frac{\pi}{2}=\frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2$$
$$\omega=\sqrt{\frac{3F\pi}{ml}}$$
$$P_F = (\tau)\ (\omega)$$
$$P_F = (F\ell)\sqrt{\frac{3F\pi}{ml}}$$
$$P_F = \sqrt{\frac{3F^3\pi l}{m}}.$$

69.[A] Virtual for any value of d_1 & d_2

70.[D] A satellite is in a state of free fall & hence weightlessness. Thus only electric force is responsible for the tension

$$T = F_e = \frac{KQ^2}{(2L)^2}$$

CHEMISTRY

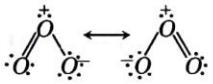
71.[D] **(A)** 

(B) Correct statement.

(C) NO^+; Bond order $= \frac{10-4}{2} = 3$

NO^-; Bond order $= \frac{10-6}{2} = 2$

Bond order बंध क्रम $\propto$ Bond strength

(D)  both bonds are equally stronger due to resonance.

72.[C] $PCl_5\,(g) \rightleftharpoons PCl_3 + Cl_2\,(g)$

P_1	–	–
$P_1(1-\alpha)$	$P_1\,\alpha$	$P_1\,\alpha$
$0.9P_1$	$0.1P_1$	$0.1P_1$

$$K_p = \frac{(0.1P_1)^2}{0.9P_1} = \frac{P_1}{90}$$

$1.1P_1 = 1\ atm$

$$P_1 = \frac{1}{1.1}$$

So, $K_p = \frac{1}{99}$

For new condition,

$PCl_5\,(g) \rightleftharpoons PCl_3 + Cl_2\,(g)$

P_2	–	–
$P_2(1-\alpha)$	$P_2\,\alpha$	$P_2\,\alpha$

$\Rightarrow P_2(1+\alpha) = 4$

$$K_p = \frac{P_2\alpha^2}{1-\alpha} = \frac{1}{99}$$

$$\alpha^2 = \frac{1}{397} \Rightarrow \alpha = 0.05$$

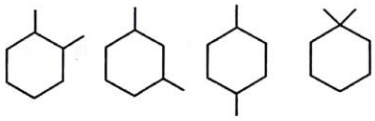
73.[C] $\frac{r_x}{r_{O_2}} = \sqrt{\frac{MO_2}{M_x}} = \left(\frac{4}{5}\right)^2 = \frac{32}{M_x}$

$M_x = 50$

$d_x = 0.80\ kg/m^3$

$$V_m = \frac{1000}{800} \times 50 = 62.5\ L$$

$$Z = \frac{PV_m}{RT} = \frac{1 \times 62.5}{0.0821 \times 500} = 1.52$$

74.[C] 

75.[B] Orthodisubsituted benzene give 2, meta gives 3 & para give 1 product on trisubstitution.

BIOLOGY

76.[C] Turn flexible

77.[B] Myxoedema

78.[D] *A, B, AB, O*

79.[D] Light → Chemical

80.[A] Imbibition

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-6

Stream – SA

Hints & Solutions

Answer key

1.(D)	2.(B)	3.(A)	4.(B)	5.(B)	6.(C)	7.(C)	8.(C)	9.(C)	10.(C)	11.(D)	12.(C)	13.(B)	14.(C)
15.(B)	16.(C)	17.(B)	18.(A)	19.(B)	20.(A)	21.(C)	22.(D)	23.(D)	24.(B)	25.(D)	26.(A)	27.(A)	28.(A)
29.(B)	30.(B)	31.(A)	32.(B)	33.(B)	34.(D)	35.(C)	36.(C)	37.(A)	38.(D)	39.(D)	40.(A)	41.(D)	42.(B)
43.(D)	44.(A)	45.(B)	46.(A)	47.(A)	48.(A)	49.(C)	50.(A)	51.(A)	52.(C)	53.(C)	54.(C)	55.(B)	56.(B)
57.(D)	58.(A)	59.(A)	60.(B)	61.(B)	62.(B)	63.(C)	64.(C)	65.(A)	66.(B)	67.(A)	68.(B)	69.(C)	70.(B)
71.(D)	72.(C)	73.(D)	74.(B)	75.(C)	76.(A)	77.(A)	78.(A)	79.(C)	80.(A)				

PART-I [One Marks Questions]

MATHEMATICS

1.[D] $(5\sqrt{41})^2 = 25 \times 41 = 1045$

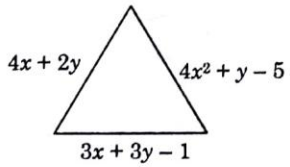
$322 = 1024$

$332 = 1089$

$\because 1024 < 1045 < 1089$

$\Rightarrow 32 < 5\sqrt{41} < 33$

2.[B]



$AB = BC$

$3x + 3y - 1 = 4x + 2y$

$\Rightarrow x - y + 1 = 0 \Rightarrow y = x + 1$

$AB = AC$

$\Rightarrow 4x + 2y = 4x^2 + y - 5$

$\Rightarrow 4x + 2(x + 1) = 4x^2 + x + 1 - 5$

$\Rightarrow 6x + 2 = 4x^2 + x - 4$

$\Rightarrow 4x^2 - 5x - 6 = 0$

$\Rightarrow 4x^2 - 8x + 3x - 6 = 0$

$\Rightarrow 4x(x - 2) + 3(x - 2) = 0$

$\Rightarrow (x - 2)(4x + 3) = 0$

$\Rightarrow x = 2, -\frac{3}{4}$

$\therefore x = 2, -\frac{3}{4}$

$y = 3, \frac{1}{4}$

$AB = 4x + 2y = 8 + 6 = 14$

$(\because \text{for } x = -\frac{3}{4} \text{ and } y = \frac{1}{4};\ 4x + 2y < 0)$

$\text{Area} = \frac{\sqrt{3}}{4} \times 14^2 = \frac{\sqrt{3}}{4} \times 196$

$= 49 \times \sqrt{3}$

$\simeq 85$

3.[A] $x = a - b + \frac{1}{a} - \frac{1}{b}$

$= a - b + \frac{b-a}{ab}$

$= (b-a)\left(\frac{1}{ab} - 1\right)$

$ab < 1$

$\Rightarrow \frac{1}{ab} > 1$ (both a & b are positive)

$\therefore x$ is always greater than zero.

4.[B] There are 9000, 4-digit numbers. From which around $\frac{9000}{11}$ numbers will be divisible by 11 & from them $\frac{9000}{11\times 10}$ numbers around will be having unit digit 3. So the numbers will be fall between $80 \le 90$.

5.[B] Angle between hands at 4 O' clock = 120°
Let the angle be 120° after x seconds

Speed of hour hand $= \left(\frac{1}{120}\right)^\circ / second$

Speed of minute hand $= \left(\frac{1}{10}\right)^\circ / second$

$\therefore$ After x seconds angle

$= \frac{x}{10} - \frac{x}{120} - 120^\circ = 120^\circ$

$\Rightarrow x = 2618.2$ seconds = 43.63 minute = 43 minute, 38.18 seconds

$\therefore$ Time = 4 Hr 43 minute 38.18 seconds

6.[C] Sum $= \lfloor 4-1 \times (1+3+5+7) \times 1111$

$= 6 \times 16 \times 1111$

7.[C] $f(x) = x^3 - 3ax^2 + 3ax - a = 0$

$; a^3 - 3a^3 + 3a^2 - a = 0$

$\Rightarrow 2a^3 - 3a^2 + 3ax - a = 0$

$\Rightarrow a(2a^2 - 3a + 1) = 0 \quad \Rightarrow a = 0$

Consider

$2a^2 - 3a + 1$

$2a^2 - 3a + 1 = 0$

$a = 1, a = \frac{1}{2}$ but at $a = \frac{1}{2}$, 2 value of x are imaginary

So, $a = 0$, $a = 1$ are only values of a.

8.[C] Let no. are x, $x+1$, $x+2$

then by options (total of no. are)

14979, 14982, 14994, 14991

$\therefore \quad 3x + 3 = 14994$

$x = \frac{14994-3}{3} = \frac{14991}{3} = 4997$

$\therefore$ other no. are 4998, 4999

$\therefore$ average $= \frac{4997+4998+4999}{3}$

$= 4998$

9.[C] Let $AG = 2x$, so $GD = x$

let $DF = y$, so $xy = 4$

Also $2x(3x + y) = 36$ [$\because AG \cdot AF = AB^2$]

& $2(9x^2 + 4) = 36 + AC^2$ (In ΔABC use Apollonius Theorem)

10.[C] Let $xy + yz + zx = \lambda$. Then

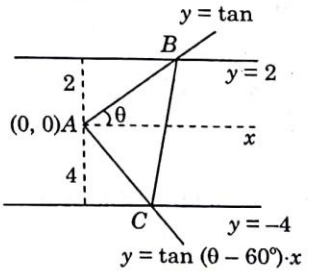
$x^2 + y^2 + z^2 - \lambda = \frac{1}{2}[(x-y)^2 + (y-z)^2 + (z-x)^2] \ge 0 \Rightarrow 1 - \lambda \ge 0.$

Again, $(x+y+z)^2 = x^2 + y^2 + z^2 + 2\lambda = 1 + 2\lambda$

$\Rightarrow 1 + 2\lambda \ge 0$

11.[D] Here $y(y^2 - 4x^2) = 0$ gives the lines $y = 0$, $y = 2x$ and $y = -2x$, which are concurrent at (0, 0).

12.[C] From the choice of the axes,



$A = (0, 0)$, $B = (2\cot\theta, 2)$,

$C = (4\cot\overline{60^\circ - \theta}, -4)$.

$\therefore$ (side of the equilateral triangle)^2

$= 4\cot^2\theta + 4$

$= 16\cot^2(60^\circ - \theta) + 16$

$\Rightarrow 4\text{cosec}^2\theta = 16\text{cosesc}^2(60^\circ - \theta)$

$\therefore \text{cosec}\theta = 2\,\text{cosec}(60^\circ - \theta)$

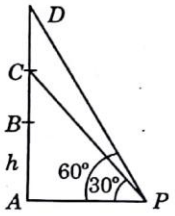
or $2\sin\theta = \sin(60^\circ - \theta)$

$\therefore 2\sin\theta = \frac{\sqrt{3}}{2}\cos\theta - \frac{1}{2}\sin\theta$

or $5\sin\theta = \sqrt{3}\cos\theta \quad \therefore \tan\theta = \frac{\sqrt{3}}{5}$

$\therefore$ the required length $= 2\text{cosec}\,\theta = 2 \times \frac{\sqrt{25+3}}{\sqrt{3}} = \frac{2\sqrt{28}}{\sqrt{3}}$

13.[B] $\frac{dx}{dt} = \frac{18}{x} = 2t + 3 \Rightarrow x = t^2 + 3t + c$



$\therefore BC = 1^2 + 3.1 + c = 4 + c$

$BD = 3^2 + 3.3 + c = 18 + c$

$\therefore \frac{h+4+c}{AP} = \frac{18}{x} = \tan 30^\circ$

$\frac{h+18+c}{AP} = \tan 60^\circ$

$\therefore \frac{14}{AP} = \tan 60^\circ - \tan 30^\circ$

$= \sqrt{3} - \frac{1}{\sqrt{3}} = \frac{2}{\sqrt{3}}$

$\therefore AP = 7\sqrt{3}.$

14.[C] Let no. of children of John and marry is y.

$x + x + 1 + y = 24$

$y = 23 - 2x$

Total no. of fights between two children

$= {}^{24}C_2 = 276$

Total no. of fights between children of same parents

$= {}^{x+1}C_2 + {}^{x}C_2 + {}^{y}C_2$

$= 3x^2 - 45x + 253$

Total no. of req.fights

$\Rightarrow N = 276 - (3x^2 - 45x + 253) \quad \ldots(1)$

$\frac{dN}{dx} = -6x + 45$

For max. or min. of N

$\because \frac{dN}{dx} = 0$

$x = 7.5 (\because x \in I)$

So x is 7

$\frac{d^2N}{dx^2} < 0$ at $x = 7$

$\because$ x will be maximum when $x = 7$ put in eq.(1)

$N = 23 - 3(7)^2 + 45(7)$

$N = 191$

15.[B] $y = 2x - 3 \quad \ldots(i)$

$y^2 = 4a\left(x - \frac{1}{3}\right) \quad \ldots(ii)$

Solve equation (i) and eq.(ii) and $D = 0$

$a = -\frac{14}{3}$

$\left|\frac{3a}{14}\right| = \left|\frac{3}{14} \times \left(-\frac{14}{3}\right)\right| = 1$

PHYSICS

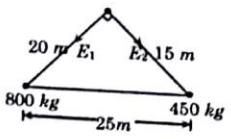
16.[C] Height is maximum when $v = 0$

Maximum height $= \frac{1}{2}(110)(1000)$

$= 55 \times 10^3\, m.$

17.[B] $E = \frac{GM}{r^2}$

$|E_1| = \frac{G \times 800}{400} = 2G \;,\; |E_2| = \frac{G \times 450}{225} = 2G$

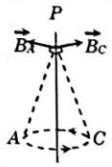


$$|E| = \sqrt{E_1^2 + E_2^2} = 2\sqrt{2}\ G$$

18.[A] when the temperature of air is increased, the pressure due to air will still remain constant. Hence remain constant.

19.[B] $\frac{\mu_3}{\mu_1}$

20.[A] The point charge move in circle as shown in figure. The magnetic field vectors at a point P on axis of circle are $\vec{B}_A$ and $\vec{B}_C$ at the instants the point charge is at A and C respectively as shown in the figure.



Hence as the particles rotates in circle, only magnitude of magnetic field remains constant at the point on axis P but its direction changes.

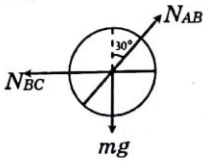
Alternate solution

The magnetic field at point on the axis due to charged particle moving along a circular path is given by

$$\frac{\mu_0}{4\pi}\frac{q\vec{v}\times\vec{r}}{r^3}$$

It can be seen that the magnitude of the magnetic field at a point on the axis remains constant. But the direction of the field keeps on changing.

21.[C] The free body diagram of cylinder is as shown. Since net acceleration of cylinder is horizontal,



$N_{AB}\cos 30° = mg$ or $N_{AB} = \frac{2}{\sqrt{3}}mg$ ...(1)

And $N_{BC} - N_{AB}\sin 30° = ma$

or $N_{BC} = ma + N_{AB}\sin 30°$ ...(2)

Hence N_{AB} remains constant and N_{BC} increases with increase in a

22.[D] $\Delta Q = mS\Delta T$

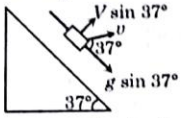
Since in boiling $\Delta T = 0$, $S = \infty$

23.[D] Applying Newton's second law to a small section of rod, we get tension at all points on rod is same.

24.[B] Because the acceleration of wedge is zero, the normal reaction exerted by wedge on block is

$N = mg\cos 37°$

The acceleration of the block is $g\sin 37°$ along the incline and initial velocity of the block is $v = 10\ m/s$ horizontally towards as shown in figure.



The component of velocity of the block normal to the incline is $v\sin 37°$. Hence the displacement of the block normal to the incline in $t = 2$ second is

$$S = v\sin 37° \times 2 = 10 \times \frac{3}{5} \times 2 = 12\ m.$$

$\therefore$ The work done by normal reaction

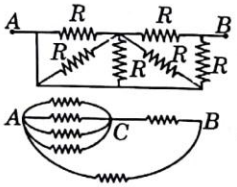
$$W = mg\cos 37° \times S = 100 \times \frac{4}{5} \times 12 = 960\ J$$

25.[D] polarization

26.[A] Since there is no change in atomic number and mass number due to the emission or absorption of a γ-ray photon ($_0\gamma^0$).

Hence (A).

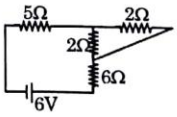
27.[A]



$R_{AB} = \frac{5R}{9}$.

28.[A] The equivalent circuit is

Equivalent resistance across cell = 12 Ω



$\therefore$ Current through cell = $\frac{6}{12} = \frac{1}{2}\ amp.$

It can be easily verified that power dissipated by 5Ω resistor is maximum.

29.[B] Rate of radiation per unit area is proportional to (T^4)

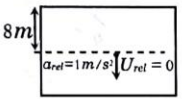
$\therefore \quad P \propto AT^4$

$\Rightarrow \quad P \propto r^2$

Also $ms\dfrac{dT}{dt} \propto AT^4 \quad \therefore \dfrac{dT}{dt} = R \propto \dfrac{1}{r}$

(because $m = (V\rho) \propto r^3$ and $A \propto r^2$)

30.[B] Relavive to lift initial velocity and acceleration of coin are 0 m/s and 1 m/s^2 downward



$\therefore 2 = \dfrac{1}{2}(1)t^2 \quad$ or $\quad t = 2$ second

CHEMISTRY

31.[A] Number of C atoms $= \dfrac{1.71}{342} \times 12 \times N_A$

$= 3.6 \times 10^{22}$

32.[B] Mole $= \dfrac{5.6}{22.4}$

$\therefore$ no. of molecule $= \dfrac{5.6}{22.4} \times 2N_a$

$= \dfrac{1}{2} \times 6.02 \times 10^{23} = 3.01 \times 10^{23}$ atoms

33.[B] K_p will remain same.

34.[D] Slope of adiabatic curve is greater than isothermal curve.

35.[C] More is the extent of overlapping between the two atomic orbitals, stronger will be bond. Thus co-axial overlapping between two p-orbitals will give the strongest σ bond.

36.[C] N_2O_5 Solid has NO_2^+ and NO_3^- ions

PCi_5 solid has PCI_4^+ and PCI_5^+ ions

XeF_6 solid has XeF_5^+ and F^- ions

ICI_3 solid exist as dimmer I_2CI_6.

37.[A] (A) For Li^{2+}, $n = 6$ to $n = 3$

For H, the similar transition is 2 to 1

For He^+, the similar transition is 4 to 2

Energy of 4th orbital of $He^+ = -13.6 \times \dfrac{2^2}{4^2}$

$= -3.4\ e.V$

38.[D] (A) Sodium metal can be produced by the electrolysis of molten $NaCl$.

(B) $CsOH$ has the maximum basicity and maximum solubility among all alkali metal hydroxides.

(C) Gypsum when heated above 393 K forms Dead Burnt Plaster.

39.[D] (D) $Li(g) + e^- \rightarrow Li^-(g)$

40.[A] $\dfrac{P_1V_1}{n_1} = \dfrac{P_2V_2}{n_2}$

$\dfrac{4 \times 2.5}{1.5} = \dfrac{P_2 \times 5}{0.75}$

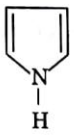
So, $P_2 = 1.0\ atm$.

41.[D] (D) A and B both

42.[B] C–2

43.[D] β-keto acid decarboxylate readily

44.[A]



45.[B] Rate of electrophilic substitution reaction ∝ Stability of arenium ion.

BIOLOGY

46.[A] Carbohydrates, fats proteins

47.[A] Stroma

48.[A] Intramolecular

49.[C] Larger than that of efferent

50.[A] Decreased amount of antidiretic hormone secretion

51.[A] Cell surface

52.[C] Chemical signals between ants

53.[C] Lysosome

54.[C] Plant cell having cell inclusions

55.[B] Interphase

56.[B] Anabaena

57.[D] Moisture

58.[A] Elastin

59.[A] Bicarbonate in blood plasma and *RBC*s

60.[B] neutrophil of female

PART-II [Two Marks Questions]

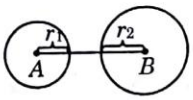
MATHEMATICS

61.[B] $\dfrac{(1+x+x^2+x^3+x^4)^{15}}{x^{30}}$

$= \dfrac{a_0+a_1x+a_2x^2+....+a_{60}x^{60}}{x^{30}} \Rightarrow$ No. of terms = 61

62.[B] Given circles are

$(x-1)^2+(y-2)^2=1$



Let $A\equiv(1,2)$, $B\equiv(7,10)$, $r_1=1$, $r_2=2$

$AB\equiv 10$, $r_1+r_2=3$

$AB>r_1+r_2$, hence the tow circles are separated.

Radius of the two circles at time t are $(1+0.3t)$ and $(2+0.4t)$

For the two circle to touch each other

$AB^2=[(r_1+0.3t)\pm(r_2+0.4t)]^2$

or $100=[(1+0.3t)\pm(2+0.4t)]^2$

or $100=(3+0.7t)^2,\ [(0.1)t+1]^2$

or $3+0.7t=\pm 10,\ 0.1t+1=\pm 10$

$\therefore t=10,\ t=90[\because t>0]$

The two circles will touch each other externally in 10 seconds and internally in 90 seconds.

63.[C] $f(x)=x^2+bx-b$

$f'(x)=2x+b$. Slope of tangent at (1, 1) is $2+b$

$\therefore$The equation of the tangent to the curve at (1, 1) is

$y-1=(2+b)(x-1)$

$\Rightarrow x-\dfrac{y}{2+b}=1-\dfrac{1}{2+b}=\dfrac{1+b}{2+b}$

$\Rightarrow \dfrac{x}{\frac{1+b}{2+b}}-\dfrac{y}{1+b}=1$

Intercept forms are $\dfrac{1+b}{2+b}$ and $-(1+b)$

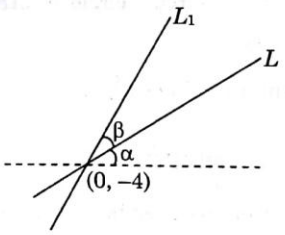
Area is $-\dfrac{1}{2}\left(\dfrac{1+b}{2+b}\right)(1+b)=2$ (given)

$(1+b)^2+4(2+b)=0$

$\Rightarrow b^2+6b+9=0$

$\Rightarrow (b+3)^2=0 \Rightarrow b=-3$ & $-b=3$

64.[C]



$\theta=\alpha+\beta=\tan^{-1}\left(\dfrac{1}{2}\right)+\tan^{-1}\left(\dfrac{1}{3}\right)=\tan^{-1}(1)$

$=\tan^{-1}(1)$

$\boxed{\theta=\dfrac{\pi}{4}}$

Equation of L_1 is $y+4=x$

$\Rightarrow\ y-x+4=0$

Let the equation of circle is

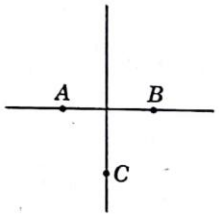
$(x-r)^2+(y+r)^2=r^2$

$\Rightarrow x^2+y^2-2xr+2yr+r^2=0$

$r = \frac{|-r-r+4|}{\sqrt{2}} \Rightarrow 2r^2 - 16r + 16 = 0$

So sum of radii is = 8

65.[A]



Coordinate of C ≡ (0, –1)

$A \equiv (x_1, 0)$

$B \equiv (x_2, 0)$

Where $x_1 + x_2 = a$ and $x_1x_2 = -1$

Equation of family of circle passing through point A & B is

$(y-0)(y-0) + (x-x_1)(x-x_2) + \lambda y = 0$

$\because$ $C(0, -1)$ lies on it

So $\lambda = 0$

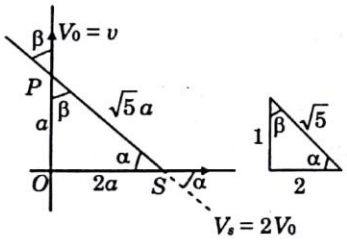
So equation of circum circle of ΔABC is

$x^2 + y^2 - ax + 1 = 0$

So coordinates of $D \equiv (0, 1)$

PHYSICS

66.[B] Let speed of observer be v, then speed of source will be $2v$, and V be the speed of sound At any time t.



$OS = 2(OP)$ [because $V_S = 2V_0$]

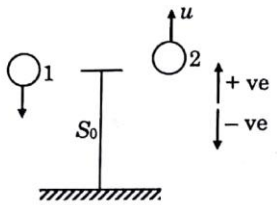
$\therefore \cos\alpha = 2/\sqrt{5}$ and $\cos\beta = 1/\sqrt{5}$

$\therefore f = f_0\left[\frac{V - V_0\cos\beta}{V + V_S\cos\alpha}\right] = f_0\left[\frac{V - V/\sqrt{5}}{V + 4V/\sqrt{5}}\right]$

f is constant and less than f_0.

67. [A] $S_1(t) = -\frac{1}{2}gt^2$ (downwards)

and $S_2(t) = ut - \frac{1}{2}gt^2$ (upwards)

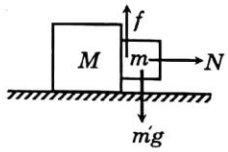


The distance between the two will be:

$S = S_1(t) + S_2(t) = ut$

Therefore, S-t graph will be a straight line passing through the origin.

68.[B]



small m has acceleration in horizontal direction = 25 m/s^2

$\therefore$ $N = ma$

$N = m \times 25$

small m slide down only when $mg > f$

$10m > f$

limiting friction = $0.5 \times m \times 25 \Rightarrow 12.5\ m$

mg is less than f_{max}

$\therefore$ mg will not able to slide down block of mass m.

this is condition of static, so limiting friction does not act

$\Rightarrow$ friction lesser than limiting friction keeps smaller block stationary with respect to larger block.

69. [C] In cyclic process $ABCA$

CA process is Isochoric

So $W_{CA} = 0$

$W_{total} = W_{AB} + W_{BC}$

AB process in isothermal

So $W_{AB} = nRT\ell n\dfrac{P_i}{P_f}$

$W_{AB} = 3R2T_0\ell n\dfrac{2P_0}{P_0} = 6RT_0\ell n2$

BC is constant pressure process

So $W_{BC} = P\Delta V = nR\Delta T = 3R(T_f - T_i) = 3R(T_0 - 2T_0) = -3RT_0$

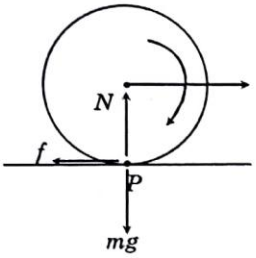
$W = W_{AB} + W_{BC}$

$= 6RT_0\ell n2 - 3RT_0 = 3RT0(2\ell n2 - 1)$

$= 1.16\ RT_0$

70.[B] Net torque about point of contact $P = 0$

$\therefore$ Angular momentum about P = conserved



$mv_0R = I\omega + mvR$

$mv_0R = mR^2\left(\dfrac{v}{R}\right) + mvR$

$v = \dfrac{v_0}{2}$

$K_i = \dfrac{1}{2}\,mv_0^2$

$K_f = \dfrac{1}{2}mv^2 + \dfrac{1}{2}\,I\omega^2 = \dfrac{1}{2}m\left(\dfrac{v_0}{2}\right)^2 +$

$\dfrac{1}{2}mR^2\dfrac{v_0^2}{4R^2} = \dfrac{1}{4}mv_0^2$

work energy theorem

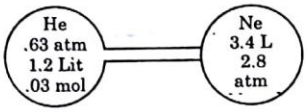
$W_{out} = \Delta kE$

work done by friction $= kE_f - kE_i$

$= \dfrac{1}{4}mv_0^2 - \dfrac{1}{2}mv_0^2 = -\dfrac{1}{4}mv_0^2$

CHEMISTRY

71.[D]



At opening of valve number of moles of both container is added.

Total pressure after connecting the bulb

$P_1V_1 + P_2V_2 = P_R(V_1 + V_2)$

$.63 \times 1.2 + 2.8 \times 3.4 = P_R(1.2 + 3.4)$

$P_R = 2.33\ atm$

$P_{He} = x_e \times P_R = 0.0714 \times 2.33 = 0.166\ atm$

72.[C] $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

The no. of moles of H_2 produced = 1mole

Vol. of $H_2(g)$ produced $= \dfrac{0.082 \times 300}{1} L =$

$24.6\ L = 24.6 \times 10^{-3} m^3$

$\therefore$ in open beaker, $\Delta W = -P_{ext} \times \Delta V$

$= -10^5 \times 24.6 \times 10^{-3} = -2460\ J$

In a closed vessel, $\Delta V = 0$ and $\Delta W = 0$

Work done in isochoric process is zero.

73.[D] $[H^+] = 10^{-3}\ M$, $[H^+] = 10^{-4}\ M$, $[H^+] = 10^{-5}\ M$ for the given acids.

$M_{mix}V_{mix} = M_1V_1 + M_2V_2 + M_3V_3$

$M_{mix} \times 3 = 10^{-3} \times 1 + 10^{-4} \times 1 + 10^{-5} \times 1$

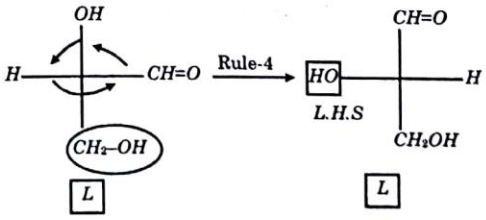
$M_{mix} = \dfrac{10^{-5}[100 + 10 + 1]}{3} = \dfrac{111 \times 10^{-5}}{3}$

$= 37 \times 10^{-5}\ M$

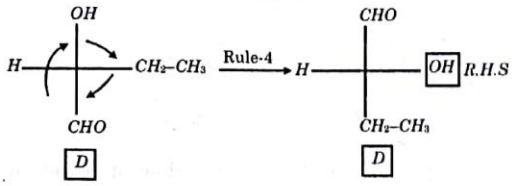
$= 3.7 \times 10^{-4}\ M$

74.[B]

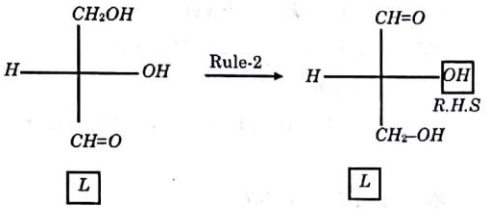
(A)



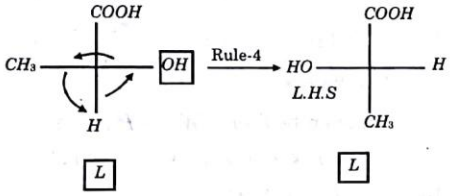
(B)



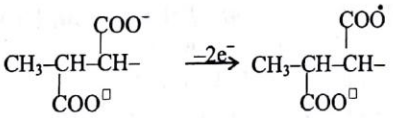
(C)



(D)

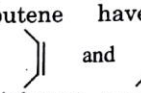


75.[C]



$$\xrightarrow{-2CO_2} CH_3\text{–}\dot{C}H\text{–}\dot{C}H\text{–} \rightarrow CH_3\text{–}HC{=}CH\text{–}$$

2 butene have two stereo isomers and and due to less steric repulsion



cis butene trans butene

trans 2 butene is more stable.

76.[A] Fructose

77.[A] *Ophioglossum*

78.[A] Anaphase

79.[C] Casparian strips

80.[A] Cell wall

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-7

Hints & Solutions

Answer Key

1.(D)	2.(C)	3.(B)	4.(B)	5.(B)	6.(C)	7.(B)	8.(D)	9.(B)	10.(A)	11.(D)	12.(B)	13.(D)	14.(B)
15.(B)	16.(B)	17.(A)	18.(D)	19.(A)	20.(C)	21.(C)	22.(C)	23.(D)	24.(B)	25.(A)	26.(A)	27.(A)	28.(A)
29.(A)	30.(D)	31.(C)	32.(D)	33.(D)	34.(B)	35.(A)	36.(A)	37.(A)	38.(B)	39.(A)	40.(A)	41.(C)	42.(C)
43.(B)	44.(B)	45.(B)	46.(C)	47.(D)	48.(B)	49.(D)	50.(B)	51.(A)	52.(A)	53.(D)	54.(B)	55.(B)	56.(C)
57.(B)	58.(A)	59.(C)	60.(D)	61.(B)	62.(C)	63.(A)	64.(C)	65.(A)	66.(D)	67.(C)	68.(A)	69.(A)	70.(B)
71.(B)	72.(B)	73.(B)	74.(D)	75.(D)	76.(D)	77.(D)	78.(A)	79.(A)	80.(A)				

PART-I [One Marks Questions]

MATHEMATICS

1.[D] Four digit numbers possible are $3 \times 3 \times 2 = 18$

Five digit numbers possible are $4 \times 3 \times 2 \times 1 = 24$

Total numbers = 42

2.[C] Given equation can be written as

$$b = -\left(\cos^4 x + \frac{1}{\cos^4 x}\right)$$

$b \le -2 \; \forall \; x \in R$

3.[B] $a_k = (k^2+1)k!$

$= (k(k+1) - (k-1))k!$

$= k(k+1)\,k! - (k-1)k!$

$= k(k+1)\,! - (k-1)k!$

$\therefore a_1 = 2! - 0$

$a_2 = 2.3! - 2!$

$a_3 = 3.4! - 2.3!$

$\vdots \quad \vdots \quad \vdots \quad \vdots$

$a_k = k\,(k+1)! - (k-1)k!$

Adding

$a_1 + a_2 \ldots\ldots + a_k = k\,(k+1)!$

$\Rightarrow b_k = k\,(k+1)!$

$$\therefore \frac{a_k}{b_k} = \frac{(k^2+1)k!}{k(k+1)!}$$

$$\frac{a_k}{b_k} = \frac{k^2+1}{k(k+1)}$$

$$\therefore \frac{a_{100}}{b_{100}} = \frac{10001}{10100} = \frac{m}{n}$$

$\therefore n - m = 99$

4.[B]

$$\frac{1}{t_n} = \frac{1}{n(n+1)(n+2)} = \frac{1}{2}\left[\frac{1}{n(n+1)} - \frac{1}{(n+1)(n+2)}\right]$$

$\therefore S =$

$$\sum_{n=1}^{n} \frac{1}{t_n} = \frac{1}{2} \times \left[\left(\frac{1}{1.2} - \frac{1}{2.3}\right) + \left(\frac{1}{2.3} - \frac{1}{3.4}\right) + \ldots\ldots + \left(\frac{1}{n(n+1)} - \frac{1}{(n+1)(n+2)}\right)\right]$$

$S_n = \frac{1}{2}\left[\frac{1}{2} - \frac{1}{(n+1)(n+2)}\right]$ If $n \to \infty$ then $S = \frac{1}{4}$

5.[B] Let co-ordinates of points are
$P_1(at_1^2, 2at_1)$, $P_2(at_2^2, 2at_2)$,
$Q_1\left(\frac{a}{t_1^2}, \frac{-2a}{t_1}\right)$
$Q_2\left(\frac{a}{t_2^2}, \frac{-2a}{t_2}\right)$
$\therefore$ equation of P_1P_2 is
$(t_1 + t_2)\, y = 2\,(x + at_1t_2)$ ... (*i*)
equation of Q_1Q_2 is
$(t_1 + t_2)\, y + 2\,(x\, t_1\, t_2 + a) = 0$ ... (*ii*)
Solving (*i*) & (*ii*)
$x = -a$

6.[C] Put $x = \omega, \omega^2$
$(3 + \omega + \omega^2)^{2010} = a_0 + a_1\omega + a_2\omega^2 + \ldots$
$\Rightarrow 2^{2010} = a_0 + a_1\omega + a_2\omega^2 + a_3 + a_4\omega + \ldots$
and $2^{2010} = a_0 + a_1\omega^2 + a_2\omega + a_3 + a_4\omega^2 + \ldots$
Adding (1) and (2), we have
$2 \times 2^{2010} = 2a_0 - a_1 - a_2 + 2a_3 - a_4 - a_5 + 2a_6 - \ldots$
$\Rightarrow 2^{2010} = a_0 - \frac{1}{2}a_1 - \frac{1}{2}a_2 + a_3 - \frac{1}{2}a_4 - \frac{1}{2}a_5 + a_6 \ldots$

7.[B] Put $x^2 + x = y$, so that the equation (1) becomes
$(y-2)(y-3) = 12$
$\Rightarrow y = 6, -1$
When $y = 6$, we get $x^2 + x - 6 = 0$
or $x = -3, 2$
When $y = -1$, we get $x^2 + x + 1 = 0$
$\Rightarrow x = \omega, \omega^2$ and their sum is -1

8.[D] Let the two digit number be $10x + y$ whose sum of digits is 6.
$\Rightarrow x + y = 6$ ... (*i*)
$\therefore 10x + y + 18 = 10y + x$
$\Rightarrow 9x - 9y = -18$
$\Rightarrow x - y = -2$ ... (ii)
On solving Eqs. (*i*) and (*ii*)
$x = 2$ and $y = 4$
$\therefore$ Required two digit number is 24.

9.[B] $a679b$ is divisible by 72.
$\Rightarrow a679b$ is divisible by 9 and 8.
$\Rightarrow$ A number is divisible by '8' if last three digits are divisible by '8' *i.e.*, $79b$ is divisible by '8'
$\Rightarrow b = 2$.
Also, $a679b$ is divisible by '9' if sum of digits is divisible by '9'
i.e., for some 'M' $\frac{a+6+7+9+b}{9} = M$
$\Rightarrow a + b + 22 = 9M$
$\Rightarrow a + 24 = 9M$
For $M = 3 \Rightarrow a = 3$
For $M = 4 \Rightarrow a = 12$
(*i.e.*, not possible as $1 < a \le 9$)
$\therefore a = 3$ and $b = 2$

10.[A] Number $= 625^2 + 4 = (5^2)^4 + 4$
Let us consider,
$x^4 + 4 = x^4 + 4x^2 + 4 - 4x^2$
$= (x^2 + 2)^2 - (2x)^2$
$= (x^2 + 2 + 2x)(x^2 + 2 - 2x)$
$\therefore 5^4 + 4 = \{(5^2)^2 + 2(5^2) + 2\}\{(5^2)^2 - 2(5^2) + 2\}$
$= (577)(677)$
$\therefore$ Two prime factors are 577 and 677.

11.[D] Let common difference of A.P. is d. then
Let $p = \lambda, q = \lambda + d, r = \lambda + 2d, s = \lambda + 3d$
$\because p + q = 2 \Rightarrow 2\lambda + d = 2$ ....(1)
and $r + s = 18 \Rightarrow 2\lambda + 5d = 18$ ....(2)
on solving (1) & (2) $\lambda = -1$ & $d = 4$
so $p = -1, q = 3, r = 7, s = 11$

12.[B] For the nearest point on the curve, tangent drawn to curve at that point should be parallel to the given line
$\therefore 6x_1 - 8y_1\left(\frac{dy}{dx}\right)_{(x_1, y_1)} = 0$
$\Rightarrow \left(\frac{dy}{dx}\right) = +\frac{3}{4} \cdot \frac{x_1}{y_1} = -\frac{3}{2} \Rightarrow x_1 = -2y_1$
which satisfy $3x^2 - 4y^2 = 72$
$\Rightarrow 12y_1^2 - 4y_1^2 = 72$
$\Rightarrow y_1^2 = 9 \Rightarrow y_1 = \pm 3 \Rightarrow x_1 = \mp 6$
Hence required points are $(-6, 3)$ and $(6, -3)$.

13.[D] α is common root

$5\alpha^2 + a\alpha + 1 = 0$

$4\alpha^2 + h\alpha + 1 = 0$

$\alpha = b - a$

$\alpha\beta_1 = 1/5 \Rightarrow \frac{1}{\beta_1} = 5\alpha$

$\alpha\beta_2 = 1/4 \Rightarrow \frac{1}{\beta_2} = 4\alpha$

$\frac{1}{\beta_1} + \frac{1}{\beta_2} = 9\alpha = 9(b-a)$

14.[B] $\sum_{r=0}^{n} \frac{(-1)^r (n+1)!}{(r+2)!(n-r)!} = \frac{1}{n+2} \sum_{r=0}^{n} (-1)^r \, {}^{n+2}C_{r+2}$

$= \frac{1}{n+2} [{}^{n+2}C_2 - {}^{n+2}C_3 + {}^{n+2}C_4 - {}^{n+2}C_5 .....]$

$= \frac{1}{n+2} [({}^{n+2}C_0 - {}^{n+2}C_1 + {}^{n+2}C_2 - {}^{n+2}C_3 ....)$

$-({}^{n+2}C_0 - {}^{n+2}C_1)]$

$= \frac{1}{n+2} [{}^{n+2}C_1 - {}^{+2}C_0] \left[\because \sum_{r=0}^{n+2} (-1)^r \, {}^{n+2}C_r = 0 \right]$

$= \frac{1}{n+2} [n + 2 - 1] = \frac{n+1}{n+2}$

15.[B] Let $P(\alpha^2, \alpha^3)$, $Q(\beta^2, \beta^3)$, $R(\gamma^2, \gamma^3)$

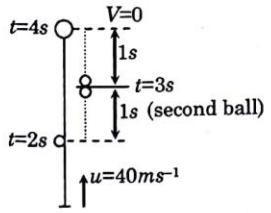
P, Q, R are collinear

$$\begin{vmatrix} \alpha^2 & \alpha^3 & 1 \\ \beta^2 & \beta^3 & 1 \\ \gamma^2 & \gamma^3 & 1 \end{vmatrix} = 0 \Rightarrow \alpha\beta + \beta\gamma + \gamma\alpha = 0$$

so $\frac{1}{\gamma} + \frac{1}{\alpha} + \frac{1}{\beta} = 0$

PHYSICS

16.[B]



$u = 40$ m/s, $g = 10$ m/s^2

Let t be time taken by the first ball to reach the highest point

$V = u - gt \Rightarrow 0 = 40 - 10t \Rightarrow t = 4$ s

After reaching the first ball at the highest point now both the balls will collide after 1 sec as both the balls cover equal distances in opposite directions during 1 sec.

therefore, the height of collision point

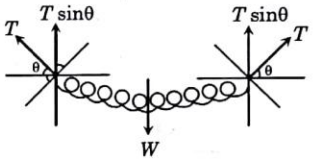
= height gained by the second ball in 3 sec

$= 40(3) - \frac{1}{2}(10)(3)^2$

$= 120 - 45$

$= 75$ m **"B" Ans**

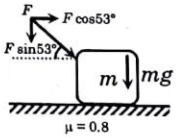
17.[A]



$2T \sin\theta = W$

$T = \frac{W}{2}$ cosec θ

18.[D] To Slide



$F \cos 53° > \mu_s (mg + F \sin 53°)$

$\frac{3F}{5} > 0.8\, mg + \frac{3.2}{5} F$

Which is impossible, so block cannot slide. This situation is called self-locking.

19.[A] $W_f + W_G = \Delta K$

$-\mu mgd - mgh = 0 - \frac{1}{2} m v_0^2$

$\mu gd + gh = \frac{1}{2}(v_0^2)$

$(0.6)(10)\, d + 10(1.1) = 18$

$d = \frac{7}{6} = 1.1666 \approx 1.17$

20.[C] $V_{max} = A\omega = 5 \Rightarrow A\,\frac{2\pi}{4} = 5$

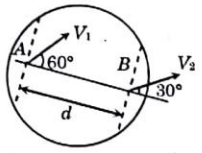
$\Rightarrow A = \frac{10}{\pi}\,cm.$

21.[C] $V_{av} = \sqrt{\frac{8KT}{\pi m}}$, as T = constant

$\therefore \quad V_{av} = \text{constant}$

22.[C] Let velocity of projection be V and velocity of the block when it returns back = V'
then $V > V'$ (since some *K.E.* is lost to friction)
Hence average velocity during ascent > average velocity during descent
$\Rightarrow \quad t_a < t_d$

23.[D] For rigid body separation between two point remains same.
$v_1 \cos 60° = v_2 \cos 30°$



$\frac{v_1}{2} = \frac{\sqrt{3}v_2}{2} \quad \Rightarrow v_1 = \sqrt{3}v_2$

$$\omega_{disc} = \left|\frac{v_2 \sin 30° - v_1 \sin 60°}{d}\right| = \left|\frac{\frac{v_2}{2} - \frac{\sqrt{3}v_1}{2}}{d}\right|$$

$$= \left|\frac{v_2 - \sqrt{3} \times \sqrt{3}v_2}{2d}\right| = \frac{2v_2}{2d} = \frac{v_2}{d}$$

$\omega_{disc} = \frac{v_2}{d}$

24.[B] As Volume decreases
$\therefore$ pressure of the gas in the cylinder increases

25.[A] by $A_1 V_1 = A_2 V_2$

$$\left(\frac{\pi D_1^2}{4}\right) V_1 = \left(\frac{\pi D_2^2}{4}\right) V_2$$

$V_2 = 4V_1$

26.[A] $W = \vec{F} \cdot (\vec{r}_2 - \vec{r}_1) = 100\ J$

27.[A] If mass = m
first ball will stop $\Rightarrow v = 0$
so $K.E = 0$ (min)
($K.E$ can't be negative $K.E.$)

28.[A] $P = i^2 R$
$32 = i^2 (2)$
$i = 4A$
$P_{max} = (2)^2 (2) + (2^2)2 + (4)^2 (2)$
$= 8 + 8 + 32 = 48\ W$

29.[A] $v = \omega\sqrt{A^2 - r^2}$ .....(*i*)
$a = \omega^2 r$ .....(*ii*)
from (*i*) and (*ii*)

$$\frac{v^2}{\omega^2 A^2} + \frac{a^2}{\omega^4 A^2} = 1$$

It is the equation of ellipse

30.[D] As $\langle P \rangle = 2\pi^2 f^2 A^2 \mu v$ put values
$90 = 2 \times 10 \times f^2 \times 25 \times 10^{-4} \times 4 \times 10^{-2}$
$\sqrt{\frac{100}{4 \times 10^{-2}}}$
$\Rightarrow f = 30\ Hz$

CHEMISTRY

31.[C] Mass of the solute remains same before and after dilution
$100 \times 1.5 \times 0.8 = (100 + V) \times 1 \times 0.4$
$V = 200\ ml$

32.[D] Since B is in infrared region and A has more energy than B hence it will have lesser wave length *i.e* ultra violet, visible or infrared region.

33.[D] $P\hat{O}P$ angle is 180°

34.[B] $N_{cal} = 4.8 \times 10^{-10}\ e.s.u. \times 10^{-8}\ cm$
$= 4.8 \times 10^{-18}\ esu\ cm$
$= 4.8\ D.$

$\therefore$ % ionic character $= \frac{1.2}{4.8} \times 100 = 25\%$

$\therefore$ %co-valent character = 75%

35.[A] Initially $P'_{O_2} = \frac{3}{11}P$ (total pressure)

After removal of one mole

$$P'_{O_2} = \frac{2}{10}P = \frac{P}{5}$$

$$\% \text{ decreases} = \frac{\frac{3}{11}P - \frac{P}{5}}{\frac{3}{11}P} \times 100 = 26.66\ \%$$

36.[A] Basic strength of the oxides increase in the order $Li_2O < Na_2O < K_2O < Rb_2O < Cs_2O$. The increase in basic strength is due to the decrease in *I.E.* down the group.

The melting point of the halides decrease in the order $NaF < NaCl < NaBr < NaI$, because of the decrease in lattice energies, as the size of the halide ion increases.

37.[A] In *X*, *IV*th *I.P.* is very large & in *Y* second *I.P* is very large

38.[B] Can be seen by drawing isochore lines in the *PV* graph, greater the volume in isochoric process smaller will be the slope of that isochoric line. Hence the result can be obtained.

39.[A] $K_c = [CO_2] = 0.05$ mole/litre

So moles of $CO_2 = 6.50 \times 0.05$ moles = 0.3250 moles

$CaCO_3 \rightleftharpoons CaO + CO_2$

1 mole of CO_2 = 1 mole of $CaCO_3$

0.3250 moles of CO_2 = 0.3250 moles of $CaCO_3$= 0.3250×100 *gm* of $CaCO_3$ = 32.5 *gm* of $CaCO_3$

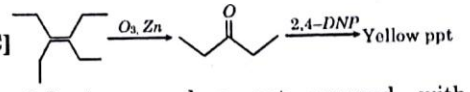
40.[A]

	$A + 2B \rightleftharpoons 2C$		
Initial moles	2	3	2
At eqm.	2.5	4	1

Molar conc. 2.5/2 = 1.25 4/2 = 2 ½ = 0.5

$$K = \frac{(0.5)^2}{1.25 \times (2)^2} = 0.05$$

Note that 1 mole of *C* has reacted to form 1 mole of *B* and 0.5 mole of *A*.

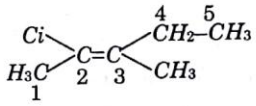
41.[C] 

3-Pentanone dose not respond with Tollen's reagent and *NaOI*

42.[C] Aceataldehyde is the most polar among the above compounds. Because polarity order is $-CHO > I > OR > NH_2$.

43.[B] Factual

44.[B] Both the methyl group on the same side of double bond so it has cis configuration.



45.[B] In hydrazine carbon is absent so it can not form *NaCN* salt with sodium. So it can not give Lassaigne's test for nitrogen.

BIOLOGY

46.[C] Amoeboid, malariae

47.[D] None above

48.[B] Three pairs thoracic and six pair abdominal

49.[D] Plasma cells

50.[B] Catalyst

51.[A] P_{50} with a decrease in CO_2 conc

52.[A] Store oxygen to be utilized during muscle contraction

53.[D] (A) and (B)

54.[B] Vagus

55.[B] A reduction in vasopression secretion fro posterior pituitary

56.[C] *ssRNA* not enclosed by protein coat

57.[B] Megasporangium

58.[A] Rough *ER* has ribosomes

59.[C] Centriole

60.[D] Nature of *R* group

PART-II [Two Marks Questions]

MATHEMATICS

61.[B] $T_n = [\,n\,(n+1) - (n-1)]\,\underline{n}$

$= n\,\underline{n+1} - (n-1).\underline{n}$

Now put $n = 1, 2, 3, \ldots\ldots, n$ and add

62.[C] $x^2 - y^2 = (x+y)\,(x-y)$

Total ways of selecting

(x, y) is $15 \times 15 = 225$.

Favorable cases are either $(x-y)$ or $(x+y)$ is divisible by 13.

(*i*) $(x-y)$ is divisible by 13

if $x = 15, y = 2$ → 2 cases

$x = 14, y = 1$ → 2 cases

&

$x = 15, y = 15$ } 15 cases

$x = 14, y = 14$ }

.....

$x = 1, y = 1$ } 19 cases

(*ii*) $(x+y)$ is divisible by 13, if

$x = 2, y = 11$

.....

$x = 6, y = 7$

$x = 12, y = 1$

$x = 11, y = 2 \Rightarrow$ 12 cases

63.[A] $4x^2 + 2x - 1 = 0 \rightarrow \alpha, \beta$

$4\alpha^2 + 2\alpha - 1 = 0$ ...(1)

$\alpha + \beta = -\frac{1}{2}, \quad \alpha = \frac{1-4\alpha^2}{2}$ ...(2)

$\Rightarrow \beta = -\frac{1}{2} - \alpha = -\frac{1}{2} - \frac{1-4\alpha^2}{2}$ [using(2)]

(1) can be written as $2\alpha^2 + 2\alpha^2 + 2\alpha - 1 = 0$

$\Rightarrow 2\alpha^2 - 1 = -2\alpha(1+\alpha)$

$\therefore \quad \beta = -2\alpha\,(1+\alpha)$

64.[C] $T_r = \sqrt{1 + \frac{1}{r^2} + \frac{1}{(r+1)^2}}$

$= \sqrt{\frac{r^2(r+1)^2 + r^2 + (r+1)^2}{r^2(r+1)^2}}$

$= \sqrt{\frac{r^2(r^2+2r+1) + 2r^2 + 2r + 1}{r^2(r+1)^2}}$

$= \sqrt{\frac{r^4 + 2r^3 + 3r^2 + 2r + 1}{r^2(r+1)^2}}$

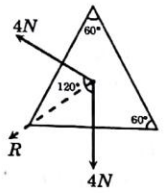
$= \sqrt{\frac{(r^2+r+1)^2}{r^2(r+1)^2}}$

$= \frac{r^2+r+1}{r(r+1)}$

65.[A] Locus is a parabola, because this is the distance of the point $P(z)$ from the line $(2+i)\,z + (2-i)\,\bar{z} - 3 = 0$ and *RHS* is the distance of $P(z)$ from the point whose affix is 1.

PHYSICS

66.[D] $R = \sqrt{4^2 + 4^2 + 2.4.4\,\cos 120°} = 4N$



67.[C] From (*i*) *A* and *C* both are charged, either positively or negatively.

From (*ii*) Both *D* and *E* has no charge and from (*iii*), *A* is positively charged.

Therefore from (*i*), *B* is negatively charged.

68.[A] 50°

69.[A] ℓ

70.[B] $_{92}U^{228}$ and $_{92}U^{234}$ are isotopes similarly $_{90}Th^{234}$ and $_{90}Th^{230}$ are isotopes.

CHEMISTRY

71.[B] $Z = 1 + \frac{Pb}{RT}$ at high pressure

$$\text{Slope} = \frac{b}{RT} = \frac{\pi}{492.6}$$

$$\Rightarrow b = \frac{\pi}{492.6} \times 0.0821 \times 300 \text{ and}$$

$$b = \frac{4}{3}\pi r^3 \times 4\,N_A$$

$$= \frac{\pi}{492.6} \times 0.0821 \times 300 \times 10^{-3}$$

$$\Rightarrow r = 2.5\,\text{Å} \text{ or } d = 5\text{Å}$$

72.[B] $H_2O(s) \rightleftharpoons H_2O(\ell)$

$\Delta V = 18.01 - 19.64 = -1.63\ ml = -1.63 \times 10^{-3}\ L$ [1 L bar = 100 J]

$$\frac{\Delta P}{\Delta T} = \frac{\Delta S}{\Delta V} \therefore \frac{\Delta P}{-10K} = \frac{22.04 J/K}{-1.63\times10^{-3} L}$$

$$\therefore \Delta P = \frac{(-10\times22.04)J}{-1.63\times10^{-3}L} \times \frac{1Lbar}{100J}$$

$= 1.35 \times 10^3$ bar {1 bar = 0.987 atm}

$= 1330$ atm

73.[B] $Ca(OH)_2 : K_{sp} = 7.9 \times 10^{-6} = 4s^3$

$\Rightarrow S = 1.25 \times 10^{-2}\ M$

$CaCO_3 : K_{sp} = 4.8 \times 10^{-9} = S^2$

$\Rightarrow S = 6.9 \times 10^{-5}\ M$

$CaSO_4 : K_{sp} = 2.4 \times 10^{-4} = S^2$

$\Rightarrow S = 1.55 \times 10^{-2}\ M$

$CaF_2 : K_{sp} = 3.9 \times 10^{-11} = 4S^3$

$\Rightarrow S = 2.13 \times 10^{-4}\ M.$

Hence, $CaCO_3$ is least soluble.

74.[D] (A) $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-OH$

(B) $CH_3-\underset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-CH_2-OH$

(C) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-OH$

(D) $CH_3-\underset{\displaystyle OH}{\overset{\displaystyle 2^\circ \text{ alcohol}}{\overset{|}{\underset{|}{CH}}}}-CH_3$

75.[D] (*I*) Stability according to cycloalkene before 11 membered ring. Cis > trans

(*II*) Trans > cis

(*III*) Hydrogen bonding

(*IV*) Gauche effect

(*V*) Hydrogen bonding in undissociated form

(*VI*) Maximum possible group should be at equatorial position.

BIOLOGY

76.[D] Sugar candy

77.[D] Lactic acid accumulation

78.[A] Capillary rise and suction

79.[A] More in the smaller one than the larger one

80.[A] ATP

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-8

Stream – SA

Hints & Solutions

Answer key

1.(C)	2.(A)	3.(D)	4.(C)	5.(D)	6.(C)	7.(B)	8.(D)	9.(C)	10.(D)	11.(A)	12.(C)	13.(A)	14.(B)
15.(D)	16.(B)	17.(C)	18.(C)	19.(B)	20.(B)	21.(A)	22.(C)	23.(D)	24.(A)	25.(A)	26.(C)	27.(D)	28.(A)
29.(B)	30.(B)	31.(C)	32.(A)	33.(A)	34.(B)	35.(B)	36.(D)	37.(B)	38.(C)	39.(C)	40.(A)	41.(C)	42.(A)
43.(A)	44.(B)	45.(D)	46.(B)	47.(C)	48.(D)	49.(D)	50.(B)	51.(A)	52.(B)	53.(B)	54.(A)	55.(A)	56.(C)
57.(B)	58.(B)	59.(D)	60.(A)	61.(A)	62.(C)	63.(C)	64.(C)	65.(C)	66.(D)	67.(D)	68.(A)	69.(A)	70.(B)
71.(C)	72.(B)	73.(A)	74.(D)	75.(D)	76.(C)	77.(B)	78.(B)	79.(B)	80.(C).				

PART-I [One Marks Questions]

MATHEMATICS

1.[C] $a^4 + b^4 + c^4 + 2(a^2b^2 + b^2c^2 + c^2a^2) = 1$

$a^4 + b^4 + c^4 = 1 - 2(a^2b^2 + b^2c^2 + c^2a^2)$ ...(1)

Now $(a + b + c)^2 = 0$

$\sum a^2 + 2\left(\sum ab\right) = 0$

$\Sigma ab = -\frac{1}{2}$ ...(2)

$(ab + bc + ca)^2 = \frac{1}{4}$

$a^2b^2 + b^2c^2 + c^2a^2 + 2abc(a + b + c) = \frac{1}{4}$

$a^2b^2 + b^2c^2 + c^2a^2 = \frac{1}{4}$

form (1) $a^4 + b^4 + c^4 = \frac{1}{2}$

2.[A] $a^3 + b^3 = 8b^3 \cos^3 80 + b^3$

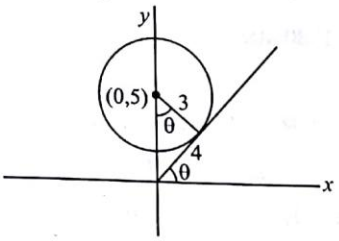
$= b^3 (1 + 2 (3 \cos 80^\circ + \cos 240^\circ)$

$= 6\, b^3 \cos 80^\circ$

$= 3\, (2b \cos 80).b^2$

$= 3\, ab^2 \Rightarrow$ (A)

3.[D] See the figure



$|z - 5i| \le 3$

the point is $(4 \cos \theta, 4 \sin \theta)$

$\left(4.\frac{3}{5}, 4.\frac{4}{5}\right) \Rightarrow \left(\frac{12+16i}{5}\right)$

4.[C] Tangent at P and Q are ;

$\frac{x \cos\theta}{a} + \frac{y \sin\theta}{b} = 1$ & $\frac{x}{a} \cos\theta + \frac{y}{a} \sin\theta = 1$

subtracting $y \sin\theta \left(\frac{1}{b} - \frac{1}{a}\right) = 0$

$\Rightarrow y = 0 \Rightarrow$ (C)

5.[D] Slope of bisector is 1

$$\therefore \frac{1-\frac{1}{t_1}}{1+\frac{1}{t_1}} = \pm\frac{\frac{1}{t_2}-1}{1+\frac{1}{t_2}}, \text{ i.e. } \frac{t_1-1}{t_1+1} = \pm\frac{1-t_2}{1+t_2}$$

i.e. $t_1 + t_1t_2 - 1 - t_2 = t_1 - t_1t_2 + 1 - t_2$

or $t_1 = t_2$ (not possible)

$\therefore\ t_1t_2 = 1$

$\therefore$ x-coordinate of P is a

Hence the locus is $x = a$ which is the line of the latus rectum

6.[C] 1, 2, 3, 4, 5, 0

A number divisible by 25 if the last two digits are 25 or 50

A number divisible by 25 if the last two digits are $50 = 4 \times 3 \times 2$

A number divisible by 25 if the last two digits are $25 = 3 \times 3 \times 2$

total = 42

7.[B] $\frac{{}^3C_2.{}^2C_2}{{}^5C_2.{}^6C_2} = \frac{1}{50}$

8.[D] $\cos A = \frac{25+36-16}{2.5.6} = \frac{3}{4}$

$\Rightarrow \cos 3A = 4\cos^3 A - 3\cos A = -\frac{9}{16}$

Also $\cos B = \frac{36+16-25}{2.6.4} = \frac{9}{16}$

$\Rightarrow \cos 3A = -\cos B \Rightarrow 3A + B = \pi$

9.[C] $K = \frac{1}{2}\left[\sin\frac{\pi}{18}\left\{2\sin\frac{7\pi}{18}\sin\frac{5\pi}{18}\right\}\right]$

$= \frac{1}{2}\left[\sin\frac{\pi}{18}\left\{\cos\frac{2\pi}{18} - \cos\frac{2\pi}{3}\right\}\right]$

$= \frac{1}{4}\left[2\cos\frac{2\pi}{18}\sin\frac{\pi}{18} + \sin\frac{\pi}{18}\right]$

$= \frac{1}{4}\left[\sin\frac{\pi}{6} - \sin\frac{\pi}{18} + \sin\frac{\pi}{18}\right] = \frac{1}{8}$

10.[D] $\cos A + \cos B - \cos C$

$= 2\cos\frac{A+B}{2}\cos\frac{A-B}{2} - \left(1 - 2\sin^2\frac{C}{2}\right)$

$= -1 + 2\sin\frac{C}{2}\left[\cos\frac{A-B}{2} + \sin\frac{C}{2}\right]$

$= -1 + 2\sin\frac{C}{2}\left[\cos\frac{A-B}{2} + \cos\frac{A+B}{2}\right]$

$-1 + 4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$

11.[A] $\because\ x \in (0, 1) \Rightarrow x^2 \in (0, 1)$

but $x^2 < x$

$\Rightarrow \cos x^2 > \cos x$ and $\sin x^2 < \sin x$

12.[C] $A < B$

13.[A] Assuming $arg\ z_1 = 0$ and $arg\ z_2 = 0 + \alpha$

$$\frac{az_1}{bz_2}\cdot\frac{bz_2}{az_1} = \frac{a|z_1|e^{i0}}{b|z_2|e^{i(0+\alpha)}} + \frac{b|z_2|e^{i(0+\alpha)}}{a|z_1|e^{i0}}$$

$$= e^{-i\alpha} + e^{i\alpha} = 2\cos\alpha$$

14.[B] $2\left|z - \frac{1}{2}\right| = |z-1| \qquad \therefore \frac{|z-1|}{|z-\frac{1}{2}|} = 2$

So Locus of z is a circle

15.[D] $|z-i| = 2\frac{|iz - i\bar{z} + 2|}{2|-i|}$

& since i lies on $iz - i\bar{z} + 2 = 0$

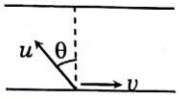
$\therefore$ locus of z is a pair of straight lines

PHYSICS

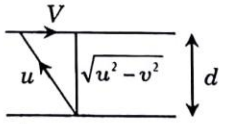
16.[B] u = speed of boat in still water i.e. velocity of boat with respect to water.

v = velocity of river

d = displacement to cross the river i.e. width of river.



boat is going at angle θ relative to river



$t = \frac{d}{\sqrt{u^2 - v^2}}$

$\frac{15}{60}\ hr = \frac{1km}{\sqrt{u^2 - v^2}}$

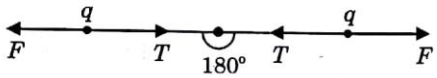
$u^2 - v^2 = 16$

$v = \sqrt{u^2 - 16}$

$= \sqrt{5^2 - 16}$

$= 3\ km/hr$

17.[C] In satellite $g = 0$ so both string are at angle 180° as no force is acting on q in downward direction



18.[C] Illumination of bulbs is proportional to power dissipate in bulb, each bulb has resistance = R

current through each bulb = $\frac{220}{R_{eq}} = \frac{220}{40R}$

$P = i^2R = \left(\frac{220}{40}\right)^2 \frac{1}{R}$

when 39 bulbs are connected in series then $R_{eq} = 39\ R$

$i = \frac{220}{39}R$

then $P' = \left(\frac{220}{39}\right)^2 \frac{1}{R}$

% change in illumination = $\left(\frac{P'-P}{P}\right) \times 100$

$= \left(\frac{P'}{P} - 1\right) \times 100 = 5\%$

19.[B] Both the springs are in series

$\therefore K_{eq} = \frac{k(2k)}{k+2k} = \frac{2k}{3}$

Time period $T = 2\pi\sqrt{\frac{\theta}{K_{eq}}}$

where μ = reduced mass = $\frac{m_1 . m_2}{m_1 + m_2}$

Here $\mu = \frac{m}{2}$

$\therefore T = 2\pi\sqrt{\frac{m}{2} . \frac{3}{2k}} = 2\pi\sqrt{\frac{3m}{4k}}$

20.[B] Newton law of cooling

$\frac{\theta_f - \theta_i}{\Delta t} = -k\ [\theta - \theta_0]$

where $\theta = \frac{\theta_i + \theta_f}{2}$ and θ_0 is surrounding temperature.

From 40° to 36° : $\theta = \frac{40+36}{2} = 38$

$\frac{36-40}{2} = -k\ [38 - 20]$

$k = \frac{2}{18}$

From 36° to 32° : $\theta = \frac{36+32}{2} = 34$

$\frac{32-36}{t} = \frac{-2}{18}[34 - 20]$

$\frac{-4}{t} = \frac{-14 \times 2}{18}$

$t = \frac{18}{7}$ min = 2 min 33 sec

21.[A] Velocity of sound wave = $v = \sqrt{\frac{\gamma RT}{M}}$

$\therefore \frac{v_2}{v_1} = \sqrt{\frac{\gamma_2}{\gamma_1} . \frac{m_1}{m_2}}$

v_2 = velocity in nitrogen & $\gamma_{N_2} = \gamma_2 = \frac{7}{5}$

v_1 = velocity in helium & $\gamma_{He} = \gamma_1 = \frac{5}{3}$

$\Rightarrow v_2 = \frac{\sqrt{3}}{5}\ v_0$

22.[C] $\vec{F} = mg\ (-\hat{j})$

$\vec{v} = v_x\hat{i} + v_y\hat{j}$

v_x at any time t is same as initial because F on body is in downward direction. so it acceleration is only in vertical direction thus horizontal velocity remain constant.

$v_x = v\cos\theta\ \hat{i}$

$a_y = g$ downward due to gravity force

$\therefore v_y = (u\sin\theta - gt)\ \hat{j}$

$\vec{v} = u\cos\theta\ \hat{i} + (u\sin\theta - gt)\ \hat{j}$

Instantaneous power is $P = \vec{F}.\vec{v}$

$P = (-mg\ \hat{j}).[u\cos\ \hat{i} + (u\sin\theta - gt)\ \hat{j}]$

$P = -mg\ u\sin\theta + mg^2t$

so it is straight line

23.[D] Thrust force act $\perp$ to motion so in the direction of motion only one force is acting *i.e.* F

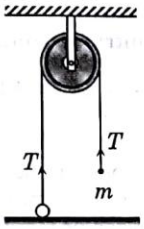
$a = \frac{F}{m}$

at time t $m = m_0 + \mu t$

$\therefore$ acceleration at time $t = \frac{F}{(m_0 + \mu t)}$

24.[A] When string get taut impulsive force will act on m as well as $2m$ due to string.

T is impulsive force



Impulse momentum theorem

$T\Delta t = m(v - v')$

Δt is time duration for impulsive force. v' is the velocity just before taut.

v = velocity just after taut

$T\Delta t = 2mv'$

$2mv' = mv - mv'$

$v' = \frac{v}{3}$

v is obtained by kinematics equation

$v^2 = u^2 + 2as$

$v = \sqrt{2g \times 2\ell} = \sqrt{4g\ell}$

$\therefore v' = \frac{\sqrt{4g\ell}}{3} = \frac{2\sqrt{g\ell}}{3}$

25.[A] $\vec{P}_i = m(3\hat{i} + \hat{j})$, $\vec{P}_f = m\left(-\frac{3}{2}\hat{i} + \hat{j}\right)$

$\therefore \Delta\vec{P}$ = impulse = $\vec{P}_f - \vec{P}_i = -\frac{9}{2}m\hat{i}$

26.[C] $P = \frac{3t^2}{2}$

$P = Fv = mav = m\frac{dv}{dt} \times v$

$m\frac{dv}{dt}v = \frac{3t^2}{2}$

$2v\,dv = \frac{3}{2}t^2\,dt$; $2\int_0^v v\,dv = \frac{3}{2}\int_0^2 t^2 dt$

$2\frac{v^2}{2} = \frac{3}{2}\left(\frac{t^3}{3}\right)_0^2$; $v^2 = \frac{1}{2}(8) = 4\ m/s$

$v = 2\ m/s$

27.[D] $\because$ Area under F-t graph = change in momentum = $P_f - P_i = \Delta P$

Momentum at $t = 0$, $P_1 = mV = 1 \times 25 = 25$

after 5 sec momentum get change to P_2

change in momentum is area under the curve from $t = 0$ to $t = 5$ sec

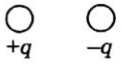
$\Delta P = -\frac{1}{2} \times 5 \times 10 = -25$

$P_2 - P_1 = -25$

$P_2 = -25 + P_1$

$P_2 = -25 + 25 = 0$

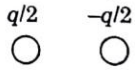
28.[A]



From coloumb law $F = \frac{kq_1q_2}{r^2}$

$F_0 = \frac{kq^2}{r^2}$

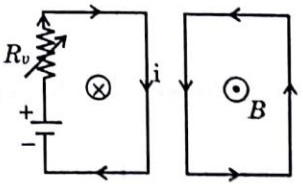
After half of charge is transferred



$F = \frac{kq^2}{4r^2}$

$\therefore F = \frac{F_0}{4}$

29.[B]



When R_v increase 'i' decrease due to which B decrease, ϕ decrease.

$\therefore$ $i_{\text{induced current}}$ is anticlockwise.

30.[B] $F_t = v_r \frac{dm}{dt} - v(\alpha v) = -\alpha v^2$

$a = \frac{F_t}{M} = \frac{-\alpha v^2}{M}$

CHEMISTRY

31.[C]

	A	+	B	$\rightleftharpoons$	C	+	D
Initial	1		1		0		0
At equili.	$(1-x)$		$(1-x)$		x		x

$\therefore K_c = \frac{[C][D]}{[A][B]} = 9$

$\therefore \frac{x.x}{(1-x)^2} = 9$

or $x^2 = 9 + 9x^2 - 18x$ or $8x^2 - 18x + 9 = 0$

$\therefore x = \frac{3}{2}$ or $\frac{3}{4}$

32.[A] $2H_2O(g) + 2Cl_2(g) \rightleftharpoons 2HCl(g) + O_2(g)$

$K_p = 0.03$ $T = 427^\circ = 700\ K$

$K_p = K_c (RT)^1$

33.[A] $r_1 - r_2 = 24 \times (r_1)_H$

$\frac{0.529 \times n_1^2}{1} - \frac{0.529 \times n_2^2}{1} = 24 \times 0.529$

$\therefore (n_1^2 - n_2^2) = 24$

34.[B] $Cr\ (Zn = 24)$

electronic configuration is :

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

so, no. of electron in $\ell = 1$ i.e. p subshell is 12 and no. of electron in $\ell = 2$ i.e. d subshell is 5.

35.[B] $\frac{u_1}{u_2} = \sqrt{\frac{T_1 \times M_2}{T_2 M_1}}$

36.[D] Weight of H_2 = 20 g in 100 g mixture,

Weight of O_2 = 80 g

$\therefore$ Moles of $H_2 = \frac{20}{2} = 10$

$\therefore$ Moles of $O_2 = \frac{80}{32} = \frac{5}{2}$

$\therefore$ Total moles $= 10 + \frac{5}{2} = \frac{25}{2}$

$\therefore P_{H_2} = P_T \times$ mole fraction of $H_2 = 1 \times \frac{10}{25/2}$

$= 0.8$ bar

37.[B] Weight of $KOH = 2.8$ gram

Volume of solution = 100 ml

$M = \frac{2.8 \times 1000}{56 \times 100} = \frac{28}{56} = 0.5$ M

38.[C] $3M + N_2 \longrightarrow M_3N_2$

Let Atomic wt. of metal = a

so $(3a + 28)g$ nitride contains metal = $3a$ gram

$\therefore$ 14.8 g nitride contains metal

$= \frac{3a}{3a+28} \times 14.8 = 12$

so $a = 40$

39.[C] As charge on cations increases, their polarising power increases and thus covalent character increases.

$+ \quad 2+ \quad 3+ \quad 4+$

$LiCl < BeCl_2 < BCl_3 < CCl_4$

40.[A] Across the period (i.e. 3rd period) the size of atom decreases and nuclear charge increases. So generally the ionisation energy increases. However the ionisation energy of Mg is greater than Al because of more penetration power of $2s$ sub-shell electrons of Mg as compared to that of the $2p$ sub-shell electron of Al. Also, Mg has fully filled configuration.

41.[C] Compounds which have same molecular formula but different properties are called isomers.

42.[A] Negative inductive effect (–I) is more powerfull of halogens because of their more electron negativity so they deactivate the ring.

43.[A] $6NaCN + FeSO_4 \longrightarrow Na_4[Fe(CN)_6]$

$Na_4[Fe(CN)_6] + 4Fe^{3+} \longrightarrow Fe_4[Fe(CN)_6]_3$

(prussian blue colour)

44.[B] Strong base is required for elimination of HBr. $NaNH_2$ is stronger base so it can give alkyne by double elimination.

45.[D] Free radical substitution take place in the presence Cl_2 at the sp^3 carbon.

BIOLOGY

46.[B] Bacteriophase

47.[C] Nervous system

48.[D] 22

49.[D] Sphaerosome

50.[B] Golgibody

51.[A] 25%

52.[B] Matrix of Mitochondria

53.[B] Hinge joint

54.[A] Cytoplasm & nucleus

55.[A] Ascending limb of the loop of Henle

56.[C] Mammalian bones only

57.[B] 14, 15, 16

58.[B] 25%

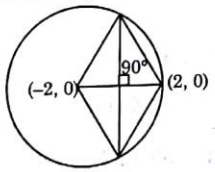
59.[D] All the above components

60.[A] Lack of lymphocytes

PART-II [Two Marks Questions]

MATHEMATICS

61.[A] Circles with centre (2, 0) and (–2, 0) each will radius '4'; y-axis is common chord.



Diagonals are 4 and $4\sqrt{3}$

$$\text{Area} = \frac{1}{2} \times d_1 \times d_2$$

$$= \frac{1}{2} \times 4 \times 4\sqrt{3} = 8\sqrt{3}\ sq.\text{units}$$

62.[C] $\tan^4 x + \cot^4 x \geq 2$

$4 \sin^2 y \geq 4 \Rightarrow \sin^2 y \geq 1$

$\Rightarrow \sin y = 1, -1$

$$\Rightarrow y = \pm \frac{\pi}{2}, \pm \frac{3\pi}{2}, \pm \frac{5\pi}{2}, \ldots.$$

But $y = \pm \frac{\pi}{2}, \pm \frac{3\pi}{2}$.

& corresponding to each value of y there are two values of x so total number of points are 8.

63.[C] 9.10.10.10 – (6.6.6.6) = 7704

64.[C] $PT = 10, PC = 5, PB = 25$

$PT^2 = PA.PB$

$(10)^2 = PA \,.\, (25) \Rightarrow PA = 4$

$PT^2 = PC.PD$

$(10)^2 = 5 \times PD$

$$\therefore PD = 20 \Rightarrow \frac{PD}{PA} + PR = \frac{20}{4} + 10 = 15$$

65.[C] $\because (2 + a\sqrt{3})^{50} + (2 + b\sqrt{3})^{50} = 5 + 4\sqrt{2}$

$\Rightarrow (2 - a\sqrt{3})^{50} + (2 - b\sqrt{3})^{50} = 5 - 4\sqrt{2} < 0$

But $L.H.S. > 0$

$\therefore$ there is no pair (a, b)

PHYSICS

66.[D] In equilibrium, torques of forces mg and Mg about an axis passing through O balance each other.

$$\text{mg}.\frac{L}{2}\cos 30° = Mg\,\frac{L}{2}\cos 60°$$

$$\Rightarrow \frac{M}{m} = \sqrt{3}$$

67.[D] If mirror is turned, about an axis perpendicular to plane of mirror, then there will be no change in incident angle and reflected angle so angle between incident and reflected rays after rotation will be same as before. Ans. 45°.

68.[A] $V = IR$

$V = I\frac{\rho\ell}{A}$

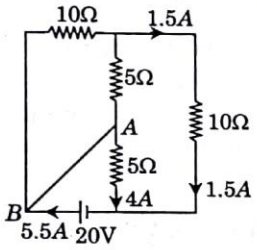
$\therefore \quad E = J\rho$

As, $J_A > J_B \Rightarrow E_A > E_B$

Now, Power $= I^2 . \frac{\rho\ell}{A} . t$

$\therefore \quad$ Power $\propto \frac{1}{A}$.

69.[A] Here in this circuit its equivalent resistance across battery can be given as



$R_{eq} = \frac{40}{11}\Omega$

Thus current through battery is

$$I = \frac{20}{40/11} = 5.5\,A$$

Thus current 1.5 A (from figure) will be divided in 10Ω & 5Ω in inverse ratio thus

$$I_{5\Omega} = \frac{1.5\times10}{15} = 1A$$

Thus current in branch AB is

$I_{AB} = 1 + 4 = 5A$ Ans.

70.[B] $F = kx$, $T_1 = ka = m\omega^2\, 2a$

$\Rightarrow \omega = \sqrt{\frac{k}{2m}}$

Time period $= \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{2m}{k}} = T$

$T_2 = 2ka = m\omega^2\, 3a$

$\Rightarrow \omega = \sqrt{\frac{2k}{3m}}$

Time period $= 2\pi\sqrt{\frac{3m}{2k}} = T'$

$T' = \left(\frac{\sqrt{3}}{2}\right)T$ Ans.

CHEMISTRY

71.[C] $\Delta H_{vap} = 40850\ J\ mol^{-1}$, $T_b = 373\ K$

$$\Delta S_{vap} = \frac{\Delta H_{vap}}{T_b} = \frac{40850J\,mol^{-1}}{373K}$$

$= 109.5\ K^{-1}\ mol^{-1}$

$$\Delta S_{vap} \text{ per gram} = \frac{109.5J\,K^{-1}mol^{-1}}{18g\,mol^{-1}}$$

$= 6.083\ JK^{-1}\ g^{-1}$

Entropy change for 3.6 g water

$= 6.083\ JK^{-1}\ g^{-1} \times 3.6\ g$

$= 21.89\ JK^{-1}$

72.[B] For $H_2(g) + O_2(g) \longrightarrow H_2O_2(\ell)$

$$\Delta_r H^\circ\ (H_2O_2,\ \ell) = \Delta_r H_3^\circ + \frac{\Delta r H_2^\circ}{2} - \frac{\Delta r H_1^\circ}{2}$$

73.[A]

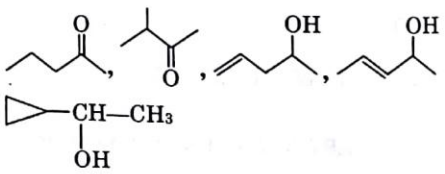
Initial	Final
pH = 12	pH = 11
$[H^+] = 10^{-12}$ M	$[H^+] = 10^{-11}$ M
$[OH^-] = 10^{-2}$ M	$[OH^-] = 10^{-3}$ M

Initial no. of mole of $OH^- = 10^{-2}$ Final no. of $OH^- = 10^{-3}$

So no. of mole of OH^- removed

$= [.01 - 0.001] = 0.009$

74.[D]



75.[D] $Ph\text{–}COOH + NaOH + CaO \xrightarrow[\text{Decarboxylation}]{\Delta} Ph\text{–}H$

$Ph\text{–}OH + Zn \text{ dust} \xrightarrow[\text{Reduction}]{\Delta} Ph\text{–}H$

BIOLOGY

76.[C] Monohydric alcohol

77.[B] 24 *hrs*

78.[B] Growth and normal functioning of cell

79.[B] *TP* opposes the entry of water

80.[C] $NADP^+$ to $NADPH + H^+$

KVPY

Kishore Vaigyanik Protsahan Yojana

Practice Set-9

Stream – SA

Hints & Solutions

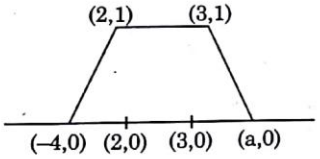
Answer key

1.(D)	2.(C)	3.(B)	4.(A)	5.(A)	6.(D)	7.(B)	8.(C)	9.(C)	10.(C)	11.(A)	12.(A)	13.(D)	14.(A)
15.(C)	16.(A)	17.(C)	18.(D)	19.(A)	20.(D)	21.(D)	22.(C)	23.(C)	24.(B)	25.(A)	26.(A)	27.(A)	28.(B)
29.(C)	30.(C)	31.(A)	32.(C)	33.(D)	34.(C)	35.(C)	36.(B)	37.(C)	38.(C)	39.(B)	40.(C)	41.(C)	42.(B)
43.(D)	44.(B)	45.(C)	46.(D)	47.(B)	48.(B)	49.(C)	50.(B)	51.(B)	52.(B)	53.(D)	54.(D)	55.(A)	56.(D)
57.(A)	58.(B)	59.(A)	60.(A)	61.(D)	62.(B)	63.(C)	64.(B)	65.(C)	66.(B)	67.(D)	68.(B)	69.(A)	70.(C)
71.(D)	72.(A)	73.(B)	74.(D)	75.(D)	76.(C)	77.(A)	78.(C)	79.(A)	80.(B)				

PART-I [One Marks Questions]

MATHEMATICS

1.[D]



$a - 3 = 2 - (-4)$

$\Rightarrow a = 9$

2.[C]

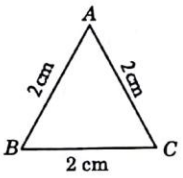


fig. (i)

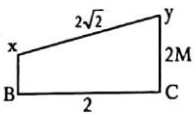
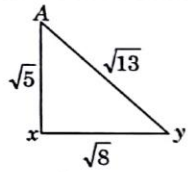


fig.(ii)

from fig. (i) & (ii)

$A = \sqrt{10}$ cm²



$Ax = \sqrt{Ab^2Bx^2}$

$Ar = \sqrt{AC^2BY^2}$

$= \sqrt{13}$

Area of $\Delta AXY = \frac{1}{2}\sqrt{5}\ \sqrt{8} = \sqrt{10}$

3.[B] $2x - 3y = 5$ ....(i)

$3x - 4y = 7$ ....(ii)

centre is point of intersection of (i) & (ii)

$\pi r^2 = 154$

$\Rightarrow r^2 = 7^2$

$\Rightarrow r = 7$

equation of circle $(x - 1)^2 + (y + 1)^2 = 47$

$x^2 + y^2 - 2x + 2y = 47$

4.[A] Any tangent to the ellipse $\frac{x^2}{25}+\frac{y^2}{5}=1$ at a point in the first quadrant is

$y = mx+\sqrt{25m^2+5}$

perpendicular distance from centre of circle to the tangent is equal to radius

$$\left|\frac{0+0+\sqrt{25m^2+5}}{\sqrt{m^2+1}}\right| = 3$$

$\Rightarrow 16\,m^2 = 4 \qquad \Rightarrow 4\,m^2 = 1$

5.[A] Image of $(a,0)$ is $(-a, 2a)$

mid point is $(0,a)$

$\therefore$ equation of the tangent is

$$y-a=\frac{2a}{2a}(x-0)$$

$y = x + a \qquad \therefore t = 1$

$\therefore$ the point of contact is $(a, 2a)$

6.[D] Let $X = {}^{2n+1}C_{n+1} + {}^{2n+1}C_{n+2} + {}^{2n+1}C_{n+3} + \ldots + {}^{2n+1}C_{2n} + {}^{2n+1}C_{2n+1}$

using ${}^nC_r = {}^nC_{n-r}$

$X = {}^{2n+1}C_0 + {}^{2n+1}C_1 + {}^{2n+1}C_2 + \ldots + {}^{2n+1}C_n$

adding $2X = {}^{2n+1}C_0 + {}^{2n+1}C_1 + \ldots + {}^{2n+1}C_{2n} + {}^{2n+1}C_{2n+1}$

$= 2^{2n+1} \Rightarrow X = 2^{2n} = 4^n$

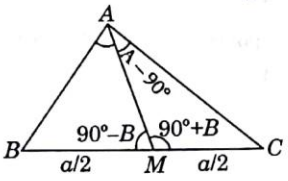
7.[B] $\lambda - 1 > 0$ and $16 - (\lambda - 1)(\lambda + 4) < 0$

$\Rightarrow \lambda^2 + 3\lambda - 20 > 0$

$$\Rightarrow \lambda > \frac{-3+\sqrt{89}}{2}$$

By (1) and (2), least integral value is 4.

8.[C] Using $m - n$ theorem



$$a\cot(90+B) = \frac{a}{2}\cot 90^\circ - \frac{a}{2}\cot(A-90^\circ)$$

$$\Rightarrow \frac{\tan A}{\tan B} = -2$$

9.[C] Slopes of the line PQ and PR are

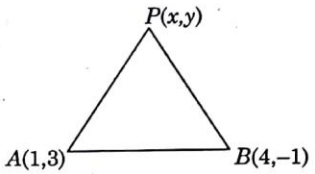
$$\tan(\theta+\pi/4) = \frac{1+\tan\theta}{1-\tan\theta} = \frac{1-2}{1+2} = -\frac{1}{3} \text{ and } 3$$

$\therefore$ equation of the lines PQ and PR are $x + 3y - 5 = 0$ and $3x - y - 5 = 0$

$\therefore$ combined equation of PQ and PR is

$3x^2 - 3y^2 + 8xy - 20x - 10y + 25 = 0$

10.[C]



$AP + BP = 5$

$AB = \sqrt{9+16} = 5$

$\therefore \; AB = AP + PB$

$\therefore$ P lies on line segment AB

11.[A] $\sin 2x + \cos 4x = 2$ is possible only if $\sin 2x = \cos 4x = 1$.

Now $\cos 4x = 1$

$\Rightarrow \sin 2x = 0$, which is not the case

$\therefore$ No solution is possible

12.[A] $x \in \left[0, \frac{\pi}{2}\right] \Rightarrow \sin x + \cos x \geq 1$

$\Rightarrow \sin 2x + \cos 2x \leq -2$, which is not possible

Aliter

$\sin 2x \geq 0, \cos x \geq 0, \sin x \geq 0$ and $1 + \cos 2x \geq 0$

Hence no solution

13.[D] We know that

$$-\sqrt{5} \leq 2\sin x + \cos x \leq \sqrt{5}, \; \forall\, x \in R$$

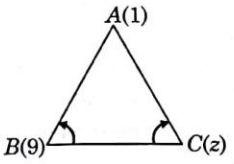
$$\Rightarrow -5 \leq \sqrt{5}\,(2\sin x + \cos x) \leq 5$$

$$\Rightarrow 0 \leq \sqrt{5}\,(2\sin x + \cos x) + 5 \leq 10$$

$$\Rightarrow -\infty < \log_{\sqrt{10}}(\sqrt{5}\,(2\sin x + \cos x) + 5) \leq 3$$

Hence range is $(-\infty, 3]$

14.[A]



taking rotation about B

$$\frac{-8}{z-9} = 2e^{iB} \quad \text{....(i)}$$

taking rotation about C

$$\frac{1-z}{9-z} = 2e^{-iB} \quad \text{....(ii)}$$

multiplying (i) and (ii)

$$\frac{8(1-z)}{(z-9)^2} = 4$$

or $(z-9)^2 - 2(1-z) = 0$

or $z^2 - 16z + 79 = 0$

or $z = 8 \pm \frac{\sqrt{256-4\times 79}}{2} = 8 \pm i\sqrt{15}$

C is $8 + i\sqrt{15}$

15.[C] $z = r(\cos\theta + r\sin\theta)$ now $r = OA\sin\theta = 6\sin\theta$

$$z = 6\sin\theta(\cos\theta + r\sin\theta)\frac{6}{z}$$

$$= \frac{1}{\sin\theta(\cos\theta + i\sin\theta)}$$

$$= \frac{\cos\theta - i\sin\theta}{\sin\theta} = -i + \cot\theta$$

$$\Rightarrow \cot\theta - \frac{6}{z} = i$$

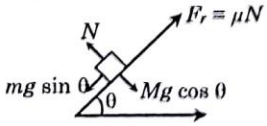
$\Rightarrow$ (C)

PHYSICS

16.[A] Body can catch ball only when both travel same horizontal distance in same time and for this both must have same horizontal velocity.

$\therefore$ velocity of boy = horizontal velocity of ball = $u\cos\theta$

17.[C] Free body diagram



From NLM

$N = mg\cos\theta$ and $mg\sin\theta = \mu N$ {$a = 0$}

$\therefore$ $mg\sin\theta = \mu\, mg\cos\theta$

$\mu = \tan\theta$

18.[D] $E = +13.6\,eV$

For He^+, $U = 2\left[\frac{-Z^2}{n^2}\times 13.6eV\right]$

$= -2\times 13.6\,eV$

$= -2E$

19.[A] Isobaric process

$Q = nC_p\Delta T$

$W = P\Delta V = nR\Delta T$

fraction of Heat used in work

$$\frac{W}{Q} = \frac{nR\Delta T}{nC_P\Delta T} = \frac{R}{C_P}$$

He is monoatomic gas, C_p for monoatomic gas = $\frac{5R}{2}$

$$\frac{W}{Q} = \frac{R}{5R/2} = \frac{2}{5}$$

20.[D] Linear momentum conservation principle.

$P_i = P_f$

$P_i = 0$ as particle is at rest.

$P_f = P_1 - P_2$

Where P_1 and P_2 are momentum of fragments

$0 = P_1 - P_2$

$\therefore$ $P_1 = P_2$

$P_1 : P_2 = 1 : 1$ & $\lambda = \frac{h}{p}$

$\therefore$ $\frac{\lambda_1}{\lambda_2} = \frac{P_2}{P_1} = 1 : 1$

21.[D] $k \propto \frac{1}{\ell}$

$\therefore \quad k_1 : k_2 : k_3 = \frac{1}{1} : \frac{1}{1} : \frac{1}{2} \Rightarrow 2 : 2 : 1$

$$\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_3} = \frac{1}{k}$$

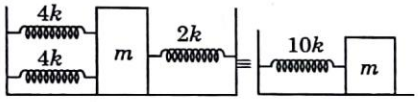
$$\frac{1}{k_1} = \frac{\frac{1}{2}}{\frac{1}{2}+\frac{1}{2}+\frac{1}{1}} \times \frac{1}{k}$$

$$\frac{1}{k_1} = \frac{1}{4} \times \frac{1}{k}$$

$k_1 = 4k,\ k_2 = 4k$

$$\frac{1}{k_3} = \frac{\frac{1}{1}}{\frac{1}{2}+\frac{1}{2}+\frac{1}{1}} \times k$$

$k_3 = 2k$



All k are in parallel combination

$\therefore \quad k_{eq} = 4k + 4k + 2k = 10k$

$$T = 2\pi\sqrt{\frac{m}{k_{eq}}}$$

$\therefore \quad T = 2\pi\sqrt{\frac{m}{10k}}$

22.[C] $h = \frac{1}{2}gT^2$

from ground after $\frac{T}{3}$,

$$H = h - \frac{1}{2}g\left(\frac{T}{3}\right)^2$$

$$= h - \frac{h}{9} = \frac{8h}{9}$$

23.[C] Slope $= \frac{\Delta V}{\Delta I}$ = Resis. $V = IR$

$\Delta V = \Delta I \times R$

$$\frac{\Delta V}{\Delta I} = R$$

Slope depend on R and R depend on temperature, length of wire and resistance of material as when temperature is increased R increase so slope will be more.

If wire of silver is used then resistivity will decrease

$\therefore$ slope will be less

If length of wire is doubled R will be doubled thus slope will be doubled

24.[B] $R_1 + R_2 = 30 \quad \ldots (1)$

Resistance of combination does not change

$\Delta R_1 + \Delta R_2 = 0$

$R_1\alpha_1\Delta T + R_2\alpha_2\Delta T = 0$

$R_1\alpha_1 = -R_2\alpha_2 \quad \ldots (2)$

$-R_1 \times 0.5 \times 10^{-3} = -R_2 \times 4 \times 10^{-3}$

$$\frac{R_1}{R_2} = \frac{40}{9.5} = \frac{8}{1}$$

(carbon) $R_1 = \frac{8}{9} \times 30 \Rightarrow \frac{80}{3}\Omega$

(Aluminium) $R_2 = \frac{1}{9} \times 30 \Rightarrow \frac{10}{3}\Omega$

25.[A] $v_I = \frac{\mu_d}{\mu} v_0$

where μ_d = refractive index of water = $\frac{4}{3}$

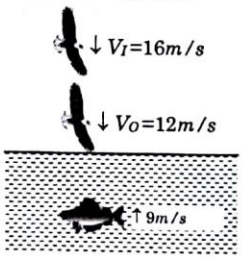
μ = refractive index of Air = 1

$= \frac{4}{3} \times 12$

$= 16\ m/s$

$\therefore$ Speed of bird as seen by fish

$= 16 + 9 = 25\ m/s$



26.[A] Using Einstein theory or relativity

$$m = \frac{m_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$ where m_0 is rest mass it is given $m = 2v_0$

$$2m_0 = \frac{m_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \Rightarrow \frac{1}{2} = \sqrt{1-\left(\frac{v}{c}\right)^2}$$

$$\Rightarrow \quad \frac{1}{4} = 1-\left(\frac{v}{c}\right)^2$$

$$\Rightarrow \quad \left(\frac{v}{c}\right)^2 = \frac{3}{4}$$

$$\frac{v}{c} = \frac{\sqrt{3}}{2}$$

27.[A] $W = U_f - Ui$

at ∞ $U = 0$ $\therefore U_f = 0$

potential due to semi circular Ring at its center $= \frac{-GM}{R}$

$$\therefore U_i = m \times \left(\frac{-GM}{R}\right)$$

$$W = U_f - Ui = 0 - \left(\frac{-GMm}{R}\right)$$

$$W = \frac{GMm}{R}$$

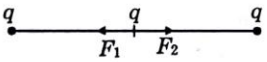
28.[B] Weins displacement law says.

$$\lambda_m \propto \frac{1}{T}$$

$$\frac{\lambda_{m_1}}{\lambda_{m_2}} = \frac{T_2}{T_1} \Rightarrow \frac{510}{350} = \frac{T_2}{T_1}$$

$$\frac{T_1}{T_2} = \frac{35}{51} = 0.69$$

29.[C] Along x-axis



$F_1 = F_2$

If q is shifted along x-axis in left direction then F_2 get increase due to which q will come back to its original position

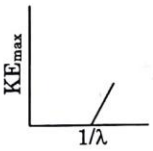
$\therefore$ along x-axis, q is in stable equilibrium

30.[C] An electric field can deflect only charged particle, $F = qE$.

X-rays, Neutrons, γ-rays are not charge particle where α is charge particle

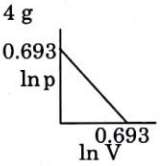
CHEMISTRY

31.[A]



32.[C] 4 g

33.[D]



34.[C] 6

35.[C] 6.02×10^{17}

36.[B] $13\sigma, 5\pi$

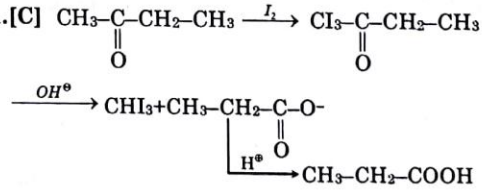
37.[C] $Cu(OH)_2.CuCO_3$

38.[C] 5

39.[B] As electronegativity difference between bonded element increases % ionic character increase.

40.[C] From graph we know that $V_B > V_A$, so expansion has taken place so w will be with –ve sign and ΔH will be +ve as both ΔE and $\Delta(PV)$ have increased.

41.[C]



42.[B] Nitrogen in pyridine is sp^2 hybridised

43.[D] Does not involve rearrangement and carbocation

44.[B] Number of *H*-bond between base pairs *A* and *T* and the base pair *G* and *C* are respectively 2 and 3.

45.[C] During denaturation secondary and tertiary structures of protein destroyed but primary structures remains intact.

BIOLOGY

46.[D] Fibrous roots

47.[B] ATP

48.[B] 2

49.[C] Oceanic algae

50.[B] Photosynthesis and transpiration

51.[B] Hypertonic solution

52.[B] Exosmosis

53.[D] All the above

54.[D] Green glands-Prawn

55.[A] The H^+ released from carbonic acid combines with haemoglobin to form haemoglobinic acid

56.[D] has a higher affinity for oxygen than that of an adult

57.[A] A = TRF, B = T.S.H, +ve control when low thyroxin level in blood and –ve control when high thyroxin level in blood

58.[B] Iron, iodine, manganese, copper zinc, fluorine

59.[A] 1–3

60.[A] External auditory canal → Tympanic membrane → Malleus → Incus → Stapes → Fenestra ovalis → scala vestibuli → Helicotrema → Scala media → organ of corti → Auditory nerve → Posteiror Colliculi → Temporal lobe of cerebrum

PART-II [Two Marks Questions]

MATHEMATICS

61.[D] Let $T_k = \dfrac{(k+2)\sqrt{k} - k\sqrt{k+2}}{k(k+2)^2 - k^2(k+2)}$

$= \dfrac{(k+2)\sqrt{k} - k\sqrt{k+2}}{2k(k+2)} = \dfrac{1}{2}\left[\dfrac{1}{\sqrt{k}} - \dfrac{1}{\sqrt{k+2}}\right]$

$\therefore T_1 = \dfrac{1}{2}\left[\dfrac{1}{\sqrt{1}} - \dfrac{1}{\sqrt{3}}\right]$

$T_2 = \dfrac{1}{2}\left[\dfrac{1}{\sqrt{2}} - \dfrac{1}{\sqrt{4}}\right]$

$T_3 = \dfrac{1}{2}\left[\dfrac{1}{\sqrt{3}} - \dfrac{1}{\sqrt{5}}\right]$ and so on

$\therefore$ As $k \to \infty$, sum $= \dfrac{1}{2}\left[1 + \dfrac{1}{\sqrt{2}}\right] = \dfrac{1+\sqrt{2}}{2\sqrt{2}}$

$= \dfrac{\sqrt{1}+\sqrt{2}}{\sqrt{8}}$

$\Rightarrow a + b + c = 11.$

62.[B] $E = (2n+1)(2n+3)(2n+5)....(4n-3)(4n-1)$

$E = \dfrac{(2n)!(2n+1)(2n+2)(2n+3)(2n+4)(2n+5)....(4n-1)4n}{(2n)!\,(2n+2)(2n+4)....(4n)}$

$E = \dfrac{(4n)!\,n!}{(2n)!\,n!\,2^n\,(n+1)(n+2).....(2n)}$

$E = \dfrac{(4n)!\,n!}{(2n)!\,(2n)!\,2^n} \Rightarrow 2^n E = n!\,{}^{4n}C_{2n}$

Hence $2^n E$ is divisible by ${}^{4n}C_{2n}$

63.[C] We have seen that the total number of positive integral solutions of $abc = 24$ is 30. We observe that any two of the factors in each factorization may be negative. Hence, Number of integral solutions = Number of positive integral solutions + Number of integral solutions having two negative factors. Thus total number of solution is 120.

64.[B] $x+\frac{1}{x}=1\Rightarrow x^2-x+1=0\Rightarrow x=-\omega,-\omega^2$

$$p=\omega^{1000}+\frac{1}{\omega^{1000}}=(\omega^3)^{333}.\ \omega+\frac{1}{(\omega^3)^{333}}.\omega$$

$$=+\frac{1}{\omega}=\omega+\omega^2=-1$$

Similarly $x=-\omega^2$ also $p=-1$

$n>1 \quad 2^n=4k \quad k\in N$

$2^{2^n}=2^{4k}=(16)^k=$ a number with last digit = 6

$q=$ (the digit at unit place in 2^{2^n}) $+1=7$

$p+q=7+(-1)=6$

65.[C] $\alpha^2-a\alpha+a+b=0$

$\beta^2-a\beta+a+b=0$

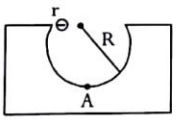
$\alpha^2-a\alpha=\beta^2-a\beta=-a-b$

$$\frac{1}{\alpha^2-a\alpha}+\frac{1}{\beta^2-a\beta}+\frac{2}{a+b}$$

$$=\frac{1}{-(a+b)}+\frac{1}{-(a+b)}+\frac{2}{a+b}=0$$

PHYSICS

66.[B]



When cylinder reaches at B

then block get shifted by x

$\therefore$ but since then there is no ext

force therefore com remain at its position

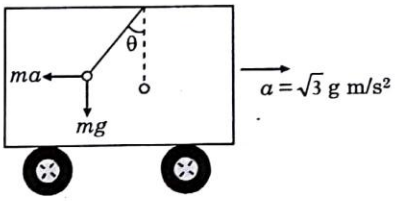
$[(R-r)-x]m=Mx$

$$\therefore x=\frac{m(R-r)}{M+m}$$

67.[D] Applying Newton's second law to a small section of rod, we get tension at all points on rod is same.

68.[B] The water will fall maximum distance if the hole is made at nearest to $\frac{1+2}{2}=1.5$ m. The nearest point is at the bottom of the container.

69.[A] With respect to the cart, equilibrium position of the pendulum is shown.



If displaced by small angle θ from this position, then it will execute SHM about this equilibrium position, time period of which is given by

$$T=2\pi\sqrt{\frac{L}{g_{eff}}};\ g_{eff}=\sqrt{g^2+(\sqrt{3}g)^2}$$

$\Rightarrow g_{eff}=2g \quad \Rightarrow$ T = 1.0 second

70.[C] $\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$$\Rightarrow \frac{1}{15}=(1.5-1)\left(\frac{1}{\infty}-\frac{1}{-R}\right)\Rightarrow R=\frac{15}{2}$$

Equivalent focal length

$$f=\frac{-R}{2n}=\frac{-15}{2\times2\times1.5}=\frac{-5}{2}\text{ cm}$$

$$\frac{1}{f}=\frac{1}{fm}-\frac{2}{f\ell}$$

$$=\frac{2}{-R}-\frac{2(n-1)}{R}\Rightarrow f=\frac{-R}{2n}$$

system behaves as a concave mirror

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}+\frac{1}{-20}=\frac{-2}{5}$$

$$\Rightarrow v=\frac{-20}{7}\text{ cm}$$

CHEMISTRY

71.[D] From MOT & bond order values.

72.[A] Probability of finding the electron at distance $r = |\psi(r)|^2 . 4\pi r^2 dr$

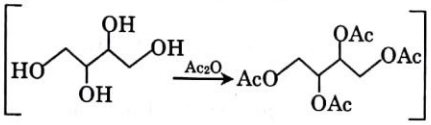
$P_1 = K_1^2 e^{-2} . \left(\frac{4}{3}\pi r_0^3\right)$;

$P_2 = K_2^2 e^{-2} . \left(\frac{4}{3}\pi r_0^3\right) \cos^2 30^\circ$

so $P_2 < P_1$

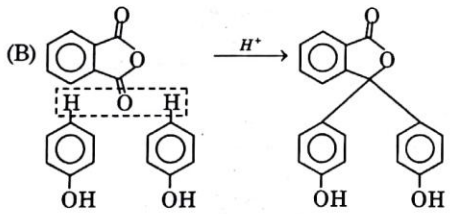
73.[B] *HA* will be stronger acid, so its solution will have lower *pH*.

74.[B] $C_4H_{10}O_4 \xrightarrow{Ac_2O} C_{12}H_{18}O_8$

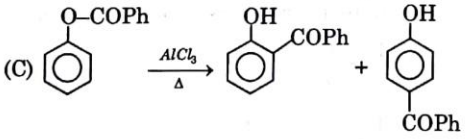


75.[D]

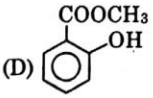
(A) $C_6H_5CHO \xrightarrow{CN^\ominus} C_6H_5-\underset{OH}{CH}-\underset{O}{C}-C_6H_5$ (Benzoin)



Phenolphthalein



Fries rearrangement



(Oil of wintergreen)

BIOLOGY

76.[C] Cholesterol is present in all living organisms

77.[A] *a*(iii), *b*(iv), *c*(i), *d*(ii)

78.[C] Iron -Chlorophyll ring structure

79.[A] Producing *ATP* only

80.[B] 36 *ATP*, 24 *NADPH*

KVPY

Kishore Vaigyanik Protsahan Yojana

Stream – SA

Practice Set-10

Hints & Solutions

Answer key

1.(C)	2.(A)	3.(A)	4.(C)	5.(B)	6.(A)	7.(C)	8.(C)	9.(D)	10.(D)	11.(A)	12.(B)	13.(A)	14.(C)
15.(C)	16.(B)	17.(C)	18.(C)	19.(B)	20.(B)	21.(A)	22.(A)	23.(B)	24.(D)	25.(B)	26.(A)	27.(A)	28.(B)
29.(A)	30.(A)	31.(D)	32.(B)	33.(B)	34.(C)	35.(B)	36.(C)	37.(D)	38.(B)	39.(C)	40.(B)	41.(D)	42.(B)
43.(D)	44.(C)	45.(A)	46.(C)	47.(C)	48.(C)	49.(C)	50.(A)	51.(A)	52.(C)	53.(C)	54.(C)	55.(B)	56.(D)
57.(D)	58.(A)	59.(B)	60.(B)	61.(B)	62.(B)	63.(C)	64.(C)	65.(A)	66.(A)	67.(B)	68.(C)	69.(B)	70.(D)
71.(C)	72.(D)	73.(C)	74.(C)	75.(D)	76.(B)	77.(A)	78.(D)	79.(B)	80.(A)				

PART-I [One Marks Questions]

MATHEMATICS

1.[C] The set A contains 10 element. Two different numbers for numerator and denominator from these can be obtained in $10 \times 9 = 90$ ways and each permutation will form a unique rational number different from one. In addition one will be formed if numerator and denominator are same hence required number is = 90 +1 = 91.

2.[A] $x^2 - (k-2)x + k^2 = 0$

$x^2 + kx + 2k - 1 = 0$ should have both roots. common or each should have equal roots.

(i) $\frac{1}{1} = \frac{-(k-2)}{k} = \frac{k^2}{2k-1}$

$\Rightarrow \quad k = -k + 2$ and $2k - 1 = k^2$

$\Rightarrow \quad k = 1$

(ii) $(k-2)^2 - 4k^2 = 0$ and $k^2 - 4(2k-1) = 0$

$(3k-2)(-k-2) = 0$ and $k^2 - 8k + 4 = 0$

have no common value, k = 1 is the only solution.

3.[A] $N = 7^{p+4} \cdot 5^q \cdot 2^3$ is perfect cube 7, 5, 2 has no common factor except 'l' least value of (q) is 3 for which 5^q is cube.

Least value of '$p + 4$' is 6 for which 7^{p+4} is cube

$p + 4 = 6 \rightarrow p = 2$

Least value of $p + q = 2 + 3 = 5$

4.[C] $A = \frac{1}{2} b^2 \sin 2\theta = b^2 \sin\theta \cos\theta$ ....(i)

$\text{cosec}\,\theta = \frac{x}{24} = \frac{65-x}{36}$

$60x = (24)(65)$

$x = 26$

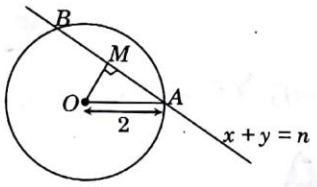
$\sin\theta = \frac{12}{13}$ and $\cos\theta = \frac{5}{13}$

$\frac{b}{\sin\theta} = \frac{65}{\sin 2\theta} \Rightarrow b = \frac{65}{2\cos\theta} = \frac{(65)(13)}{2.5}$

$= \frac{132}{2}$ and from equation (i)

$A = \frac{13^4}{4} \cdot \frac{12}{13} \cdot \frac{5}{13} = (169)\,15 = 2535$

5.[B]



$AB^2 = 4\,AM^2$

$4\left(4-\frac{n^2}{2}\right) = 2\,(8-n^2),\ n \in N$

$n = 1$ or $n = 2$

Hence required sum

$= 2\,(8 - 1^2 + 8 - 2^2)$

$= 2 \times 11 = 22$

6.[A] $S = (1)\,(2003) + (2)\,(2002) + ... + (2003)\,(1)$

$= \sum_{r=1}^{2003} r(2003-(r-1))$

$= \sum_{r=1}^{2003} r(2004-r)$

$= \sum_{r=1}^{2003} 2004\,r - \sum_{r=1}^{2003} r^2$

$= \frac{2004\times 2003\times 2004}{2} - 2003 \times 4007 \times 334$

$= 2003 \times 334 \times (6012 - 4007)$

$= 2003 \times 334 \times 2005$

$x = 2005$

7.[C] $y - mx = \pm a\sqrt{1+m^2}$

$y - nx = \pm a\sqrt{1+n^2}$

These are set of parallel line and distance between parallel lines are equal. So figure is rhombus.

8.[C] Let $x = r\cos\theta$, $y = r\sin\theta$

$\therefore\ 2r\cos\theta + 3r\sin\theta = 6$

$r = \frac{6}{2\cos\theta + 3\sin\theta}$

To find $\left(\sqrt{x^2+y^2}\right)_{min} = \sqrt{r^2} = r_{min}$

For r_{min} ; $2\cos\theta + 3\sin\theta$ should be maximum

$\therefore\ r = \frac{6}{\sqrt{4+9}} = \frac{6}{\sqrt{13}}$

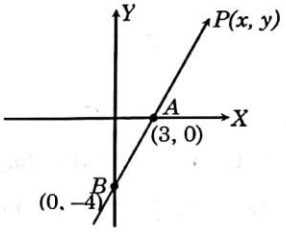
9.[D] $\Sigma a = 11, \Sigma ab = 38, abc = 40$

$\Sigma\frac{\cos A}{a} = \frac{1}{80}\Sigma(b^2+c^2-a^2)$

$= \frac{(\Sigma a)^2 - 2(\Sigma ab)}{80} = \frac{11^2-76}{80}$

$= \frac{45}{80} + \frac{9}{16}$

10.[D]



The given equation represent difference of distance PB & PA where B is $(0, -4)$ & A is $(3, 0)$

$\therefore$ Locus of P is part of line $\frac{x}{3} - \frac{y}{4} = 1$

11.[A] Let (x_1, y_1) is solution

from both equation x is symmetric

so $(-x_1, y_1)$ is also solution

but unique solution $\Rightarrow x_1 = -x_1$

$\Rightarrow x_1 = 0$

So $y_1 = \pm 1 \Rightarrow y_1 = 1 \Rightarrow a = 0 \Rightarrow (0, 1)$

$y_1 = -1 \Rightarrow a = 2$

for $a = 0$, $2^{|x|} + |x| = y + x^2$

$\Rightarrow$ $(0, 1)$ only on solution.

for $a = 2$, $2^{|x|} + |x| = y + x^2 + 2$

$\Rightarrow$ $(0, 1)$ & $(2, 0)$, $(-2, 0)$ & $(1, 0)$, $(-1,0)$

Hence $a = 0$ is acceptable

12.[B] Here $\alpha - \beta = \gamma - \delta$(As $\alpha, \beta, \gamma, \delta$ are in $A.P.$)

$\Rightarrow (\alpha-\beta)^2 = (\gamma-\delta)^2$

$\Rightarrow D_1/a_1^2 = D_2/a_2^2 \Rightarrow D_1/D_2 = a_1^2/a_2^2 = a^2/p^2$

13.[A] $S_a = a^2c \Rightarrow \frac{a}{2}[2x + (a-1)\,d] = a^2c$

$\Rightarrow 2x + (a-1)\,d = 2ac$

Similarly $2x + (b-1)\,d = 2bc$

$d = 2c$ and $x = c$

$S_c = \frac{c}{2}[2x + (c-1)d] = c^3$

14.[C] Total – (when C is always taken)
$= {}^9C_2 \times {}^9C_2 - {}^8C_1 \times {}^8C_1$

15.[C] Here $D = 0$ (As eq^n has equal roots)
so, $(27 \times 3^{1/p} - 15)^2 - 4 \times 9 \times 4 = 0$
$\Rightarrow 27 \times 3^{1/p} - 15 = \pm 12,\ 27 \times 3^{1/p} = 27$ or 3 ;
i.e., $3^{1/p} = 1$ or $3^{1/p} = 3^{-2}$
As $1/p$ cannot be zero, so $p = -1/2$

PHYSICS

16.[B] $OP = OQ \cos 60^\circ = (2R)\left(\frac{1}{2}\right) = R$

$\therefore\ h_1 = OP \cos 60^\circ = \frac{R}{2}$ (R = Radius)

$h_2 = 2R$

$\frac{v_1}{v_2} = \frac{\sqrt{2gh_1}}{\sqrt{2gh_2}} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

17.[C] At the bottom most point, square of speed of bob
$v^2 = 2\,gL(1 - \cos\alpha)$
It will rise further to a height,

$h = \frac{v^2}{2g} = L(1 - \cos\alpha)$

or $(L - l)\,(1 - \cos\theta) = L(1 - \cos\alpha)$

$\therefore\ \theta = \cos^{-1}\left[\frac{L\cos\alpha - 1}{L - l}\right]$

18.[C] Power $= \vec{F}.\vec{v} = Fv$

$F = v\left(\frac{dm}{dt}\right)$

$= v\left\{\frac{d(\rho \times (\text{volume})}{dt}\right\}$ (ρ = density)

$= \rho v\left\{\frac{d(\text{volume})}{dt}\right\} = \rho v(Av) = \rho A v^2$

$\therefore$ Power $P = \rho A v^3$ or $P \propto v^3$

Alternate Solution

Power output is proportional to number of molecules striking the blades per unit time [which depends on the velocity v of wind] and also proportional to energy of striking molecules or proportional to square of velocity v^2.

Therefore, power output $P \propto v^3$.

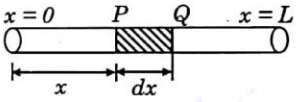
19.[B] $f = \frac{c}{4I}$ $\therefore\ \left|\frac{df}{dt}\right| = \frac{c}{4I^2}\left|\frac{dI}{dt}\right| = \frac{cv}{4I^2}$

20.[B] The motorcylist observes no beats. So, the apparent frequency observed by him from the two sources must be equal.

$f_1 = f_2$ $\therefore\ 176\left(\frac{330 - v}{330 - 22}\right) = 165\left(\frac{330 + v}{330}\right)$

Solving this equation, we get
$v = 22$ m/s

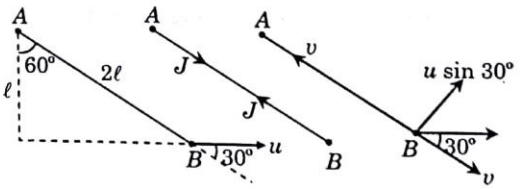
21.[A]



Mass of the element PQ is $dm = \frac{kx^2}{L}dx$

$\therefore\ x_{COM} = \frac{\int_0^L x\,dm}{\int_0^L dm} = \frac{\int_0^L \frac{Kx^3}{L}dx}{\int_0^L \frac{Kx^2}{L}dx} = \frac{\left(\frac{L^4}{4}\right)}{\left(\frac{L^3}{3}\right)} = \frac{3L}{4}$

22.[A]



When the string jerks tight both particles begin to move with velocity components v in the direction AB. Using conservation of momentum in the direction AB

$mu \cos 30^\circ = mv + mv$

or $v = \frac{u\sqrt{3}}{4}$

Hence, the velocity of ball A just after the jerk is $\frac{u\sqrt{3}}{4}$

23.[B] In pure rolling mechanical energy remains conserved, therefore speed will be same in both the cases. Acceleration of the sphere down the plane

$a \propto \sin\alpha$

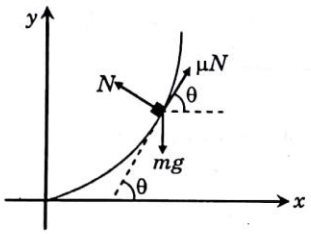
i.e., acceleration and hence, time of descend will be different.

24.[D] $P = \dfrac{\alpha T^2}{V}$ (P = constant)

$\therefore\ V = \dfrac{\alpha T^2}{P}$ or $dV = \left(\dfrac{2\alpha T}{P}\right)dT$

$$W = \int_{T_0}^{2T_0} PdV = \int_{T_0}^{2T_0} (P)\left(\frac{2\alpha T}{P}\right)dT = 3\alpha T_0^2$$

25.[B]



$\dfrac{dy}{dx} = \dfrac{x}{10}$

or $\tan\theta = \dfrac{x}{10}$ ...(i)

This angle should be angle of repose

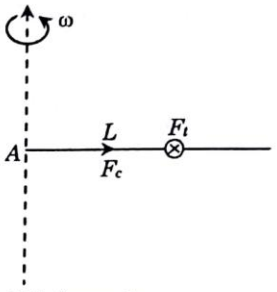
or $\tan\theta = \mu = \dfrac{1}{2}$ ...(ii)

From eqs. (i) and (ii)

$\dfrac{x}{10} = \dfrac{1}{2}$ or $x = 5$ m

$\therefore\ y = \dfrac{x^2}{20} = \dfrac{25}{20} = 1.25$ m

26.[A] Tangential force (F_t) of the bead will be given by the normal reaction (N), while centripetal force (F_c) is provided by friction (f_r). The bead starts sliding when the centripetal force is just equal to the limiting friction.



F_t is inwards

Therefore, $F_t = ma = m\,\alpha\,L = N$

$\therefore$ Limiting value of friction

$(f_r)_{max} = \mu N = \mu m\alpha L$ ....(i)

Angular velocity at time t is

$\omega = \alpha t$

$\therefore$ Centripetal force at time t will be

$F_c = mL\,\omega^2 = mL\,\alpha^2 t^2$ ....(ii)

Equating eqs. (i) and (ii), we get

$t = \sqrt{\dfrac{\mu}{\alpha}}$

For $t > \sqrt{\dfrac{\mu}{\alpha}}$, $F_c > (f_r)_{max}$ i.e., the bead starts sliding

27.[A] Angular frequency of the system,

$\omega = \sqrt{\dfrac{k}{m+m}} = \sqrt{\dfrac{k}{2m}}$

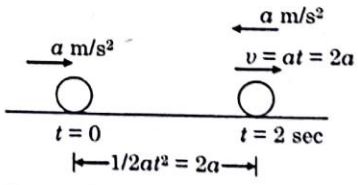
Maximum acceleration of the system will be, $\omega^2 A$ or $\dfrac{kA}{2m}$

This acceleration to the lower block is provided by friction.

Hence, $f_{max} = ma_{max}$

$= m\omega^2 A = m\left(\dfrac{kA}{2m}\right) = \dfrac{kA}{2}$

28.[B]



Let $t_0 = (2 + t)$ s

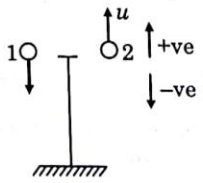
$$-2a = (2a)t - \frac{1}{2}at^2$$

$\therefore \quad t^2 - 4t - 4 = 0$

$$t = \frac{4 \pm \sqrt{16+16}}{2} = 2 + \sqrt{2}$$

$\therefore \quad t_0 = 2 + t = (4 + 2\sqrt{2})\ s$

29.[A]



$s_1(t) = \frac{1}{2}gt^2$ (downwards)

and $s_2(t) = ut - \frac{1}{2}gt^2$ (upwards)

$\therefore$ Distance between the two stones will be

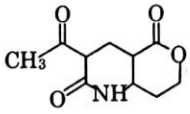
$s = s_1(t) + s_2(t) = ut$

Therefore, s-t graph will be a straight line passing through origin.

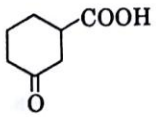
30.[A] For particle P, motion between AC will be an accelerated one while between CB a retarded one. But in any case horizontal component of its velocity will be greater than or equal to V. On the other hand, in case of particle Q, it is always equal to V. Horizontal displacement for both the particles are equal. Therefore, $t_P < t_Q$.

CHEMISTRY

31.[D] Alcohol and aldehyde

32.[B]  has ketone, amide and ester functional groups.

33.[B] 

34.[C] 

35.[B] 

36.[C] 2,4-Diemethylpent-1-ene

37.[D] It follows directly form definition of stoichiometry.

38.[B] $H_4P_2O_7 < H_3PO_3 < H_3PO_2 < P_4$

39.[C] $_{29}Cu - 3d^{10}\ 4s^1$

$Cu^+ - 3d^{10}$

(All electrons are paired therefore sum of spin quantum number comes out to be zero.)

$Cr^{24} \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

40.[B] For isoelectronic species Zeff increases with the increase of atomic number.

41.[D] Moles of NH_3 in vessel

$$= \frac{PV}{RT} = \frac{3\text{ atm} \times 82.1\ell}{0.0821 \times 300} = 10\text{ mol}$$

These moles must be present in the vessel before the equilibrium begins to move backwards and conversion of $LiCl.NH_3(s)$ to $LiCl.3NH_3(s)$ even begins.

$\therefore$ Moles of NH_3 required for conversion of $LiCl.NH_3(s)$ to $LiCl.3NH_3(s)$ is 12.

42.[B] $2NaAlO_2 + CO_2 + 3H_2O \longrightarrow Na_2CO_3 + 2Al(OH)_3\downarrow$

43.[D] None of these

44.[C] Enthalpy of neutralization is defined as amount of heat liberated when one mole of a strong acid is completely neutralized by one mole of a strong base. Its value is less in case of weak acid or weak base because small amount of heat is utilized in ionising the weak acid/ base.

ΔH for ionisation of CH_3COOH = Heat of neutralization for CH_3COOH – Heat of neutralization of strong acid

= – 50.6 – (– 55.9) kJ/mol

= + 5.3 kJ/mol

45.[A] (i) $\overset{+7}{KMnO_4} \longrightarrow Mn^{2+} \Rightarrow E_1 = \frac{39+55+64}{5}$

(ii) $\overset{+6}{K_2Cr_2O_7} \longrightarrow Cr^{+3}$

$\Rightarrow E_2 = \frac{39\times2+52\times2+16\times7}{6}$

(iii) $\overset{+5}{KClO_3} \longrightarrow Cl^- \Rightarrow E_3 = \frac{39+35.5+48}{6}$

BIOLOGY

46.[C] Air is less dense

47.[C] Chloride shift

48.[C] Duodenum

49.[C] Affects metabolism of fats by inducing lipogenesis

50.[A] Ameloblast

51.[A] First carbohydrates, next fats and lastly proteins

52.[C] Fall in blood pressure reduce *EFP*

53.[C] Can never regenerates

54.[C] Main function of cuboidal epithelium is filteration and diffusion

55.[B] Metamerism

56.[D] Herbarium

57.[D] dsDNA, Cell membrance, Cell wall

58.[A] Organisms where life cycle phases are multicelled and always free living

59.[B] Only *d* is incorrect

60.[B] Kinetochore

PART-II [Two Marks Questions]

MATHEMATICS

61.[B] $x^{57} + x^{40} + x^{21} + x^{10} + x$

$= x(x-1)(x+1)Q(x) + ax^2 + bx + c$

$x = 0,\ 0 = c$

$x = 1,\ 5 = a + b + c$

$x = -1 - 1 = a - b + c$

Solving a = 2, b = 3, c = 0

62.[B] $b = 1 + \frac{2}{c-1} \Rightarrow b$ is integer when $\frac{2}{c-1}$ is integer i.e. $c = (-1, 0, 2, 3)$

but -1, 0 get rejected as they do not satisfy the original equation, hence solutions are (2, 3), (3, 2)

63.[C] Sum of coefficient of the terms not containing c is 3^5

Sum of coefficient of the terms not containing b & c both is 2^5

$S = 3^5 - 2^5$

64.[C] When they meet for the 1st time, ashu covers

$= 800 \times \frac{5}{8} = 500$ m

and manoj covers = 300 m, now manoj ashu will run towards *B*.

When ashu covers 300 manoj will cover

$= 3 \times \frac{300}{5} = 180$

Ashu is at *B* & manoj is at 120 m from *B* and running toward *B*.

when they meet for second time, ashu covers

$= 120 \times \frac{5}{8} = 75$ or (800 – 75) m from *A*

manoj covers = 120 – 75 = 45 m or (120 – 45) m from *A*. Now manoj & ashu both will run towards *A*.

when ashu covers 725, manoj will cover

$= 725 \times \frac{3}{5} = 145 \times 3 = 435$ m

manoj will be (120 – 45 + 435) = 510 m from *B*

65.[A] $H(1) + H(2) = 2^2H(2) \Rightarrow H(2) = \frac{H(1)}{3}$

$H(1) + H(2) + H(3) = 9H(3) \Rightarrow H(3) = \frac{H(1)}{6}$

$\Rightarrow$ Similarly, $H(4) = H(1)/10$

Hence $H(x) = \frac{H(1)}{\frac{x(x+1)}{2}} = \frac{2\times2006}{x(x+1)}$

Answer $H(2005) = 2/2005$

PHYSICS

66.[A] From work-energy theorem ($W = \Delta K$)

$$Pt = \frac{1}{2}mv^2 \qquad \text{or } v = \sqrt{\frac{2Pt}{m}} \quad ...(i)$$

$$\frac{ds}{dt} = \sqrt{\frac{2P}{m}}t^{1/2} \text{ or } \int_0^s ds = \sqrt{\frac{2P}{m}}\int_0^t t^{1/2}dt$$

$$\text{or } s = \frac{2}{3}\cdot\sqrt{\frac{2P}{m}}t^{3/2} \quad ...(ii)$$

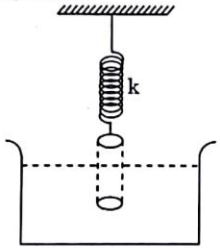
From equ. (i) & (ii)

$$\frac{s}{v} = \frac{2}{3}t \qquad \text{or } \frac{s}{v} \propto t$$

i.e., graph between $\frac{s}{v}$ and t is a straight line passing through origin.

67.[B] When cylinder is displaced by an amount x from its mean position, spring force and upthrust both will increase. Hence,

Net restoring force = extra spring force + extra upthrust



$$\text{or } F = -(kx + Ax\rho g)$$

$$\text{or } a = -\left(\frac{k + \rho Ag}{M}\right)x$$

$$\text{Now, } f = \frac{1}{2}\sqrt{\left|\frac{a}{x}\right|} = \frac{1}{2\pi}\sqrt{\frac{k + \rho Ag}{M}}$$

68.[C] At $x_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$

$\sin k x_1$ or $\sin k x_2$ is not zero

Therefore, neither of x_1 or x_2 is a node

$$\Delta x = x_2 - x_1 = \left(\frac{3}{2} - \frac{1}{3}\right)\frac{\pi}{k} = \frac{7\pi}{6k}$$

$$\text{Since } \frac{2\pi}{k} > \Delta x > \frac{\pi}{k} \Rightarrow \lambda > \Delta x > \frac{\lambda}{2} \Rightarrow \left(k = \frac{2\pi}{\lambda}\right)$$

Therefore, $\phi_1 = \pi$

and $\phi_2 = k.\Delta x = \frac{7\pi}{6} \quad \therefore \frac{\phi_1}{\phi_2} = \frac{6}{7}$

Note : In case of a stationary wave phase difference between any two points is either zero or π.

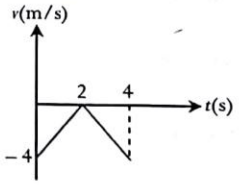
69.[B] Friction force between A and B ($= \mu mg$) will accelerate B and retard A till slipping is stopped between the two and since mass of both are equal.

Acceleration of B = retardation of $A = \mu g$

$\therefore \quad v_1 = v_0 - \mu g t$ and $v_2 = \mu g t$

Hence, the correct graph is (2). After slipping is ceased the common velocity of both will become $\frac{v_0}{2}$, which can be obtained from conservation of linear momentum also.

70.[D] v-t diagram for given situation is:



Now distance = |Area| = 8m

CHEMISTRY

71.[C] Let x gm CaC_2O_4

$$CaC_2C_4 \xrightarrow{\Delta} CaCO_3 \xrightarrow{\Delta} CaO$$

$\frac{x}{128}$ mole $\quad \frac{x}{128}$ mole $\quad \frac{x}{128}$ mole

Let $0.6 - x$ gm MgC_2O_4

$$MgC_2O_4 \xrightarrow{\Delta} MgCO_3 \xrightarrow{\Delta} MgO$$

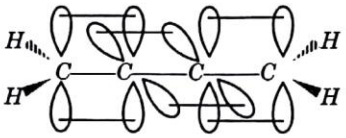
$\frac{0.6-x}{112}$ mole $\quad \frac{0.6-x}{112}$ mole $\quad \frac{0.6-x}{112}$ mole

given $\frac{x}{128} \times 100 + \frac{0.6-x}{112} \times 84 = 0.465$

$\therefore x = 0.48$ gm

weight of $CaO + MgO$

$$= \frac{0.48}{128} \times 56 + \frac{0.12}{112} \times 40 = 0.252 \text{ gm}$$

72.[D] 

73.[C] $CH_3-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{NH_3} \underset{(A)}{CH_3COO\overset{\oplus}{N}H_4}$

$\xrightarrow{\Delta} CH_3-\underset{(B)}{\overset{O}{\overset{\|}{C}}}-NH_2 \xrightarrow[NaOH]{Br_2} \underset{(C)}{CH_3NH_2}$

74.[C]

$Fe^{2+}=$ $3d^5 4s^0=$

↿⇂ ↑ ↑ ↑ ↑ | 4 unpaired e^-

$Cu^+=$ $3d^{10}$ 0 unpaired e^-

$Mn^{2+}=3d^5\ 4s^2$

↑ ↑ ↑ ↑ ↑ | 5 unpaired e^-

$V^{3+}=$ $3d^2$

↑ ↑ | 2 unpaired e^-

Magnetic moment $= \sqrt{n(n+2)}$

n = no. of unpaired e^-

75.[D] $CH_3-\overset{\oplus}{\underset{\|}{C}}(O:) \leftrightarrow CH_3-C\equiv\overset{\oplus}{O}$

Stabilize by resonance.

BIOLOGY

76.[B] Thymus - Starts undergoing atrophy after puberty

77.[A] Sympathetic and parasympathetic nerves

78.[D] The urine will be more dilute

79.[B] A differential pressure between the atrium and the vena cava

80.[A] Small intestine :

proteins $\xrightarrow{\text{Pepsin}}$ amino acids